



NEWS RELEASE

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Remarks at Opening Session
Twelfth International Congress of Astronautics
Washington, D. C.

October 2, 1961

Hugh L. Dryden
Deputy Administrator
National Aeronautics and Space Administration

It is a great pleasure and privilege to welcome the members of the Twelfth Annual Congress of the International Astronautical Federation to Washington. Many members of adhering organizations in the United States have gathered at this first meeting of the Federation in this country to greet their colleagues from other countries and to join in discussions of scientific, technical, legal, and social progress in that great human adventure, the exploration of space. We hope that you may participate not only in the many formal sessions and social events but in the informal discussions and conversations which establish and strengthen personal friendships. Those of us from Washington hope that you will have a little time for visiting some of the many points of interest, including the Smithsonian Institution, in whose halls we meet this afternoon, and other scientific centers in and near the city.

As the astronomers continually remind us, the exploration of space began centuries ago with the human eye as the sole instrument. Observed regularities in the apparent motions of the stars gave rise to the early clocks and almanacs. As science developed, new methods of measurement and more and more refined measuring instruments were developed. From the light and other electromagnetic radiation penetrating the earth's atmosphere, astronomers through the centuries have gained a tremendous amount of knowledge about the size, distance, motion, chemical composition, temperature, and other physical properties of the celestial bodies.

Today, following the pioneering work of Tsiopkovskii, Oberth, and Goddard and the more recent large-scale development of rockets for military purposes, man has at his disposal the means of sending instruments far out into space and of venturing himself for short distances to explore and to discover and to learn. In four years we have made a modest beginning and the pathway ahead is one to be followed by men of vision, courage, and faith.

The word "exploration" brings to mind the great voyages of discovery of Columbus and Magellan over the broad oceans and of Peary and Scott across the forbidding icy wastes of the polar regions. For millenniums the explorer was restricted to the surface of the earth. But in the last century he left the earth's surface for the first time in a hot air balloon, soon rising to heights of a few miles. Then on December 17, 1903, centuries after the first legends of human flight, man left the surface in controlled flight in a relatively fragile vehicle of wood, wire, and cloth which you may see in a nearby building. The exploration of space by unmanned vehicles began on October 4, 1957, when the first artificial satellite of the earth, a man-made moon, was launched into orbit. So far man has sent no less than 65 such artificial moons into orbit around the earth and four in orbit about the sun. The total weight of these objects is more than 330,000 kilograms (75 tons), not much compared with the weight of the moon, but an impressive beginning.

The International Astronautical Federation was founded in 1950. Article 1 of its first constitution stated that "the IAF shall exist to promote and stimulate the achievement of space-flight as a peaceful project." The exploration of space by man is geographical exploration on a grand scale, if we may expand the meaning of the term "geographical." Our nearest neighbor, the moon, is about 385,000 kilometers (240,000 miles) away, or roughly ten times the circumference of the earth. Venus is at a distance of about 1100 times the earth's circumference. The first steps in accomplishing the first aim of the IAF have been taken and the necessity of continuing manned exploration is widely recognized. Thus in a recent policy statement the Space Science Board of the National Academy of Sciences strongly emphasized that "planning for scientific exploration of the moon and planets must at once be developed on the premise that man will participate. . . . Man can contribute critical elements of scientific judgment and discrimination in conducting the scientific exploration of these bodies which can never be fully supplied by his instruments, however complex and sophisticated they may become."

The proposed new draft of the IAF constitution now pending for adoption at this meeting lists as the first objective "To advance the development of astronautics for peaceful purposes." This change gives recognition to the manner in which astronautics has actually developed in its first four years. In addition to activities in the manned exploration of space, great progress has been made in space science and technology and their application to practical use in weather, communication and navigation satellites as well as to the support of space-flight by man. The diversity of the titles of the papers included in the program of this congress illustrates the broad interests of the members of the Federation.

Great progress has been made in space science. Although this field is of primary interest to the Committee on Space Research of the International Council of Scientific Unions and to several of the individual international unions, the Federation has an interest in the results in relation to technology and the design of spacecraft for specific purposes. The principal goals of space science are to investigate the earth and its atmosphere and the influence of the sun upon the earth; to study and understand the nature and history of the earth, the moon, the remainder of the solar system, and the universe; and to search for the presence of life outside the earth.

The principal peaceful use, in addition to scientific investigation, which has advanced greatly during the first four years, is the application of weather satellites to global cloud observation and weather forecasting. During the week of November 13th the representatives of the meteorological services of more than 25 nations will assemble to participate in a workshop, in which these weathermen will observe the reception of cloud photographs from the current weather satellite, if it is still performing satisfactorily. They will be given practical training in the interpretation of the photographs, so that on returning home they will be able to make effective use of data transmitted to them in day-to-day forecasting. The use of satellites for worldwide communication looks equally promising.

The IAF constitution lists four additional aims which are worthy of emphasis and comment in connection with the Congress which we are opening this afternoon. They may be summarized as: (1) widespread dissemination of technical and other information; (2) stimulation of public interest and support; (3) encouragement of participation in research by international and national agencies and individuals; and (4) cooperation with international and national agencies on all aspects of the natural and social sciences related to astronautics and the peaceful uses of outer space.

This Congress is a key factor in the prompt and widespread dissemination of information on astronautics to the key scientists, engineers, and other professionals of the world. This process will be effective to the extent that space activities are carried on in the open and the results shared with the world community. Scientists and engineers need complete and detailed quantitative reporting. The interplay of free analysis and discussion by the leading research workers of the world leads to more rapid progress in every country because new results may appear anywhere within the tremendous range and scope of scientific and engineering knowledge underlying the exploration of space.

Space exploration has advanced from the realm of phantasy and dream through the stage of discussion of conceptual schemes to a demonstration of technical feasibility. The greatest needs of the immediate future are the stimulation of widespread public support nationally and internationally and the achievement of cooperative efforts on a global scale.

Widespread public support requires a major effort from all of us to interpret to people of many backgrounds not only the "how" but also the "why" of space exploration. To describe our objective merely in terms of a technical task, i. e., to send a 3-man expedition to explore the moon, fails to secure the support of many, particularly of my generation. We must explain again and again the role in a scientific and technological age of an activity which catalyzes and integrates the expansion of the frontiers of knowledge. The real values lie in the major development, in science and technology applicable to do what man will in space rather than in the mere accomplishment of man setting foot on the moon.

The large sums of money required in this effort are not spent in outer space or on the moon; they are spent in the factories, workshops, and laboratories for salaries, materials and supplies. The new knowledge and experience are transferable to other areas of industry, as in the past in the development of the automobile, airplane, and nuclear reactor. Education will profit. Society will gain through the discipline of cooperation in a major task. We must convince the public that the exploration of space is an activity of critical importance for the future of science, industry, education, and public welfare in every nation, and that funds so spent will return benefits many fold. Perhaps the lessons of the history of aeronautics may help.

Finally, a major goal of the IAF is international cooperation in astronautics. Perhaps the most significant development in the first four years of the Space Age is the growth of international cooperation in space exploration on a wide scale. In an international program under the Committee on Space Research of ICSU the first two cooperative satellite launchings will take place in the first half of calendar year 1962 and others will follow. At the last Congress in Stockholm, a symposium on small sounding rockets revealed the interest in and possibilities of sounding rocket programs as the first step in space exploration for many countries, singly or in concert, who could not as yet engage in satellite programs. As already mentioned many countries are cooperating in weather research associated with satellite observations and several are preparing to cooperate in studies of communication via the active communication satellites to be launched next year. Nineteen countries are engaged in cooperative tracking and data recording from satellites and space probes. There are growing activities in the exchange and training of personnel. I can testify from my own personal experience that international cooperation in the exploration of space does contribute to friendship and understanding among nations and that substantive scientific contributions come from the participants.

The IAF is an association of organizations, each of which is represented in the General Assembly. Within the IAF there has been established the International Academy of Astronautics and an International Institute of Space Law. These bodies are composed of elected individual members and engage in meetings and colloquia on specialized topics, the making of awards, and publication.

In closing these introductory remarks to the discussions which are to follow, I would emphasize the major importance of the role of the talented individual of vision who may come from any race or country. Every accomplishment of the human race must be preceded by the vision of that accomplishment in the mind of some individual. Many of you have read Irving Stone's "The Agony and the Ecstasy," a novel of Michelangelo, the sculptor. Before the rough lumps of marble can be transformed under the tools of the sculptor to reveal the forms imprisoned within it, the sculptor must see these forms with his mind's eye. So too with space exploration. Though finally implemented and realized by a large and highly competent group of men, each worthwhile accomplishment is first a vision in the mind of some one man. The exploration of space requires many such men of vision to be identified and supported in the many nations here represented, so that we may proceed from vision to accomplishment.

I hope that this Twelfth Congress will be outstanding in its contribution of the realization of the objectives set forth in the constitution of the Federation.



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NASA BRIEFING

MISS LOUISE DECK, Information Officer, NASA
moderator.

ARNOLD K. FRUTKIN, Director of International
Programs, NASA.

ADDISON M. ROBERG, Assistant Director,
Office of Planning and Evaluation, NASA.

MESS DICK: It is a pleasure to have you with us this afternoon.

The purpose for this was particularly for the foreign correspondents in the city for the International Astronomical Federation interested in NASA programs, and we will be glad to help you.

First we will have Mr. Frutkin, Director of our Office of International Programs, discuss our cooperative programs that we have, and NASA's policy. Then Mr. Addison Rothrock, Deputy Director of the Office of Program Planning and Evaluation, will give a talk on NASA programs.

You are welcome to ask questions after each gentleman has given his presentation.

As I think I told our correspondents who cover us regularly, this is particularly for our foreign correspondents, visitors today, to ask questions.

Mr. Arnold Frutkin.

FRUTKIN: We are delighted to have this opportunity to talk to you very informally about NASA's International programs. The occasion is a very appropriate one, since we have an International Congress meeting here.

What I should like to do is go very briefly and quickly through the various aspects of our International program so that you may derive from this an understanding that we have literally opened up all aspects of NASA's space activities to participation by other countries.

You recognize that NASA is a civilian agency, that its objectives in space research are civilian and scientific.

The program that we follow in the International Office has a complex objectives. One of them is to demonstrate the openness of our program; another is to provide opportunities for substantive contributions by the competent scientists of other countries in the general purpose of exploration of space.

In addition to this we feel that scientists abroad will have interests of their own which are valid and which they might well pursue if given some training and orientation in this early on-going program of our own.

In the satellite area; as you probably know, two years ago the United States offered to provide space in its satellites, or to launch total satellite payloads of other countries. This program, despite the long lead times that are involved in the preparation of satellites, has moved ahead very well, and I believe that our U.K. friends here today are fully aware of the program in which United Kingdom scientists are preparing with their own resources three satellites which will be launched by NASA beginning next year. The first satellite will be launched hopefully in the first half of next year.

A similar program has been worked out with Canada, in which Canadian scientists are again with their own resources and their own funds preparing a topside sounder which we will launch.

This program is often referred to abroad as the Scout program, and I should like to take this opportunity to correct this rather narrow impression.

What we have really undertaken to do is use any vehicle that is required to accomplish the objective.

In the Canadian case it will not be a Scout but rather a Thor configuration. And I believe that the same thing will turn out to be true in the case of the first British satellite.

Moving from satellites to sounding rockets -- and I believe this should be of broader interest to you because there are relatively few countries which are yet in a position to prepare total satellite payloads, but many can do work with sounding rockets -- in this field we have entered into relationships with an increasing number of countries. I believe there are nine countries, actually, with whom we have some agreement for joint sounding rocket programs.

What this means is that countries desiring to enter into space research, using sounding rockets, willing to devote some of their own resources, personnel,

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equipment and funds to this work, and having scientific objectives of mutual interest, can get help here at NASA of a similar kind.

In other words if country "A" has interests and capabilities for the preparation of given payloads of mutual interest, we might, for example, provide the sounding rockets necessary to launch those payloads.

Or on the other hands, if sounding rockets are available or can be obtained by the cooperating country, we might provide the payloads.

There is a wide range of possible methods of cooperation. This program is not only moving ahead but has already shown some results. Some of you are familiar with the sounding rocket firings from Sardinia in the joint program between NASA and the Italian Space Commission. These took place in January and April, and again in August, all of this year.

The first joint launching in a program with Sweden occurred during August, with the launching of Argus rocket from Kiruna for the study of sodium clouds.

Similar programs have been arranged with a number of countries, including Argentina, most recently Pakistan, with Norway, and a number of others.

If we proceed then from sounding rocket programs to another aspect of our own work in which we have invited and obtained participation and help from other countries we take the operation of our global network tracking stations. Here we have some two dozen stations in some 19 or 20 different countries around the globe. In most of these cases, the stations are operated wholly or in part by technicians of the host country. And in a number of cases the host country actually operates the station entirely for us with its own funds. This is true in the U.K. for the minitrack station at Slough, near Slough; it is true in Canada.

Japan operates a Smithsonian Baker-Nunn camera, and there are many other examples of this sort.

Beyond our tracking operations we have a number of opportunities in which scientists of other countries,

who are not yet prepared to do space research of their own, nevertheless may participate in the support of orbiting experiments. An example would be our meteorological program; which is of very great practical interest the world round.

In the case of the Times program we have invited all the countries which belong to the World Meteorological Organization to mount special programs of observations from the ground which are synchronized with the passes of the satellite overhead. The data they obtain is then supplemented by the satellite cloud cover data which we send to them subsequently, so that both sources may be correlated.

That work is being supplemented now by an International Meteorological Workshop which will be held here in November. At the present time some 25 or 26 countries will be sending representatives of their weather services here to study the acquisition, reduction, and the operational use of satellite cloud cover data. We feel this is a particularly important program because we are looking forward to the day, which we hope will be rather soon, when our meteorological satellites will read out continuously so that any country can receive this data and utilize it immediately in its own weather analysis operations. The workshop is designed to help people prepare for that day.

In another area of very practical considerations, communication satellites, we have initiated the same method or pattern of global cooperation at the very earliest stages of the program. The testing of our first communication satellite, Echo, was arranged with England and France for the first TransAtlantic communication by means of satellite.

Next year, in several separate programs, all under NASA cognizance, there will be the launching of a number of active repeater satellites as well as additional passive reflector communication satellites. For those programs, several countries, including England and France, almost certainly Germany and at least one South American country, will be constructing major ground terminals required for the experimental testing of these satellites.

We think in this way that we are giving effect to the President's words that our entry into the communications satellite field will be in the form of International cooperation, and we are establishing a pattern which will apply when we move out of the experimental phase into the operational phase.

One of the major requirements of other countries, relatively new in the space research field, is of course training. We have a number of programs at NASA, again following the pattern of mutual inputs, joint inputs, which would afford training -- do afford training -- to technicians and scientists from abroad. One of these is a senior associateship program operated for us by the National Academy of Sciences. Here senior scientists may get stipends, rather liberal stipends, permitting them to work a year in NASA Centers.

A second program is an adjunct to our cooperative arrangements for joint satellite or sounding rocket agreements with other countries. This provides very flexible training for technicians in our Centers, including our Wallops Island launching station.

A third program is one which we are in the process of establishing right now. This is a university training program. We have established a relationship with several universities and with the National Academy of Sciences which will permit us to bring up to 100 young graduate students from other countries to this country to study in university laboratories where space research is being conducted. In other words this is a closely integrated program which will permit foreign graduate students to come here and work with people like Van Allen and Winckler and Scum and so on, people who are engaged in actual space research rockets for NASA. This will permit these graduate students a unique combination of academic work and experimental program.

We will provide fellowships, we will defray the full university expenses of these people, we will expect the sponsoring country to pay their passage here and their subsistence.

Again, you see, we follow a pattern of joint inputs into these programs. In no case are we simply subsidizing an effort which is not strongly supported

locally abroad.

Our stations, our facilities, are open to all visitors. We have had some one thousand visitors from abroad in the last year. Their visits have included all of our laboratories and our own launching facilities at Cape Canaveral and Wallops Island.

In sum, then, we have I think a very broad program. We have had a very gratifying response abroad. The number of countries participating increases daily. In one way or another some 40 countries are participating in our own or obtaining help in their own programs. The result, is, I think, a net addition to the total output by trained people here and abroad in the general interest of peaceful exploration of space.

I would be very happy to answer any questions that you people may have.

QUESTION: Are any Soviet students included in this graduate program?

FRUTKIN: There have been no applications from Soviet students.

We have never distinguished between the East and the West in making our offers for cooperative arrangements.

QUESTION: Do any of the satellite countries have students represented?

FRUTKIN: There are no satellite countries which have students, but there is some satellite participation which has begun. For example, Czechoslovakia and Poland have both indicated that they would send representatives to our International Meteorological Workshop. Both countries have indicated a desire to participate in our TIROS III ground support program.

We are always open to cooperative interest or support on the part of the Soviet Union.

QUESTION: When you say that the students are sponsored, do you mean that they are put forward by governments of the various countries?

FRUTKIN: Not necessarily the governments. Our brochure, which will shortly be out on this University Program, to which you refer I think, states that the purpose of the program is to assist other countries in acquiring the cadres of trained people that they need to carry on a program of their own. That kind of effort should be related to a central program effort, you see, rather than be isolated or diffused among different universities.

What we have done is offer this arrangement to the national space committees or national research councils of other countries. They can sponsor the students coming here.

Is that clear?

We are providing for central sponsorship, but the national research council may or may not be government.

QUESTION: This is not open to anyone to apply? They have to filter through the governing body in their own

country first?

FRUTKIN: This is right. I think you can appreciate that it would become very difficult for us to deal with unrelated groups in a given country.

If you look at our own country you will see that there are diverse interests in space research. There are engineering interests, there are academic interests, there are government interests, there are non-government interests, there are military interests and civilian interests. This picture is true of almost all countries. We as an American Government agency cannot really become involved in choosing which groups to deal with in another country. Therefore we have in every case asked that a central group be established that we can relate to. Then the local problems can be handled locally.

QUESTION: Yes, but it depends on which central group you choose. You may choose, say, a civilian one, which is not interested in military applications, or not interested in engineering applications, but only interested in scientific applications.

FRUTKIN: You see, the governments have sponsored only single groups. There may be other groups existing, but they are not operating groups. They don't have budgets to conduct programs.

If military programs are involved, then NASA is not concerned. Military interests must go to our Department of Defense for their work.

QUESTION: Mr. Kishida would like to know, is there any bilateral agreement necessary for the joint launching.

FRUTKIN: The question of bilateral agreements, we are very flexible in this matter. We have a relationship with our own State Department which permits us to carry on discussions with the technical representatives of other countries on a technical level. As a matter of fact, we insist that this go this way. We don't want to establish technical programs through diplomatic agreements. We want to establish them through technical agreements. Once a technical understanding is reached, it is then possible, if the two countries so desire, to formalize the arrangement through some protocol or through some bilateral accord. In most cases, however, we have simply a memorandum of understanding between two agencies, usually with

subsequent government concurrence. We keep our government fully informed and we expect the representatives of the other side to keep their governments informed.

QUESTION: What would be the example of this agreement already reached in the past?

FRUTKIN: There are many examples. In the case of the British satellites, there is a formal diplomatic agreement. In the case of the Canadian satellite, there is simply a letter exchange between the Canadian agency and our own. In the case of most of the countries with which we are dealing on sounding rocket programs, there is simply a letter agreement.

QUESTION: I would like to ask two questions: the first, have you made any direct contact with the Soviet Union on the subject of joint participation in communications or meteorological satellites. The second one is, have you made any approaches to any Middle Eastern nations with a view to establishing the prospects of equatorial launching bases?

FRUTKIN: On the first question, we have, as has been stated publicly by the Administrator of NASA, approached the Soviet Union on many occasions proposing joint programs, which included meteorology, specifically, as well as other overtures. We have asked the Soviet Union to propose any first steps which it itself would be willing to move on. Thus far we have had no success.

On the second question, we have, in the broad Middle East area, some stations; for instance, in Iran -- if this falls within the general geographic description -- there is a Baker-Nunn camera. But generally speaking, we have not taken an initiative to the Middle East. On the contrary, an initiative has been taken toward us, and there was discussed in the press not long ago an overture by the United Arab Republic for a joint sounding rocket program. We are open, we were open then, and continue open to that kind of proposal. The specific time scale of the proposal made by the Egyptians did not permit us to meet their requirements. What we have done is explain to them that if they wish to enter into a program which permits us to provide the training which we consider necessary, and the time scales required for thorough scientific check-out of the program, we are open to discuss that kind of project.

QUESTION: I was thinking rather more specifically of launching bases on the lines of equatorial sites, to avoid doglegging.

FRUTKIN: I believe there has been some suggestion in the Italian press that Italy is considering proposals for equatorial launching. This kind of proposal has come up to us from many countries situated on the equator.

At the present time NASA has no requirement for an equatorial satellite launching site. Therefore, it has taken no initiative to establish such a site.

If another country were interested in establishing such a site, we should be interested to know about it, and to see what was intended, to see whether it might be worth our participation.

But the utility of an equatorial launching site has probably been grossly exaggerated. There is nothing you can do scientifically from an equatorial launching site that you cannot do in polar orbit. On the contrary, you are quite limited if you launch in an equatorial orbit.

Then as we move into larger boosters, the advantage of launching on the equator eastward becomes less important, and doglegging becomes a more simple operation.

QUESTION: When you say there is nothing that you can do in equatorial orbit that you cannot do in polar orbit, are you now referring to equatorial satellites?

FRUTKIN: I am speaking of scientific satellites and not communication satellites. You are quite right in the satellite communications field.

If you were to establish a synchronous orbit system, it would be very simple to use an equatorial launching site. But the early experimental systems we are talking about are not synchronous.

QUESTION: One last question. Have you any desire to launch from Woomera?

FRUTKIN: We have launched from Woomera. That is, the Australians have launched from Woomera for us. That is, last week there was the launching of the first Skylark

Rocket, a British rocket with an American payload, launched by Australians in a joint program at Woomera. This was for purposes of survey of ultraviolet in the Southern Hemisphere skies.

We have no other current interest in Woomera that I know of.

Are there other questions?

QUESTION: What was the British rocket?

FRUTKIN: Skylark.

QUESTION: Have you any results of that shot, yet?

FRUTKIN: I don't know of any results. There may be quick-lock results. But normally it takes a good many months before results of this kind become available.

QUESTION: Did you indicate that the first U.K. satellite must be launched by a Delta?

FRUTKIN: Yes.

QUESTION: Thor-Delta?

FRUTKIN: Yes.

QUESTION: Would that be two-stage?

FRUTKIN: Yes.

QUESTION: Plus the first stage?

FRUTKIN: Three stages; that's right.

QUESTION: Which satellite was this?

FRUTKIN: The first British satellite may well be launched not by Scout but by a Thor configuration.

QUESTION: Is there any payment involved in this?

FRUTKIN: There is no exchange of funds in any of these programs. There has been no export of dollars in this program. This is why I say that the program has produced a net gain in space research. These are projects which would

not have existed had there not been the cooperative program.

The satellites that we will be launching for the British are satellites we should like to have launched if they were not doing it. We should have had to increase our budget to provide for it.

In other words, we benefit from satellites of valid scientific purpose for which we do not have to pay. The British benefit from a launch which they would not otherwise have.

I think that there is gain all around in this program.

QUESTION: What happens of the scientific data that is acquired?

FRUTKIN: It is a cardinal principle of all these programs that the data be made available to the scientific community, fully available.

QUESTION: World-wide?

FRUTKIN: The traditional way is through publications in the scientific journals.

In addition, most of these countries are, or we hope will become members of, COSPAR and following COSPAR's procedures, will deposit the results of their work in the world data centers which have made available to all countries.

QUESTION: Are these IGY world data centers?

FRUTKIN: Yes. You remember IGY data centers covered all disciplines of the IGY. The world data centers for rocket and satellite data are now the responsibility of COSPAR, and so continue under those auspices.

QUESTION: Could I check on one point?

I am familiar with the U. K. scientific program but didn't know about the change from Thor to Delta. I am talking about U. K.-1 --

FRUTKIN: Yes.

QUESTION: Can you give any reason why the change has been made from the Scout?

FRUTKIN: As normal experience in all of this work, as you work on satellites they tend to get a little heavier, and as you work on vehicles their performance tends to prove to be somewhat less than hoped for.

As you mix these two situations, you may find that in order to achieve your objective, your scientific objectives, to assure that you achieve it, to get the inclination you want, the apogee and perigee, in other words, to put your experiments up where you want them, you had best use a vehicle with the capacity to get the job done without question.

The program has always been somewhat mislabeled abroad as the Scout program. It was never conceived only as a Scout program here, and I point to the fact that the Canadian topside sounder, which actually preceded the British program, was placed aboard a Thor in the first place.

We had always in mind to use whatever vehicle would be required for an experiment of sufficient interest, and we mean to assure that they get the orbit that is required.

At the present time it looks as though this may be a Thor, rather than a Scout.

QUESTION: You have a great deal of reliability on the Thor? Is that what is behind it?

FRUTKIN: I hate to put it that way. The Thor has proved to be very reliable, extremely reliable. The Scout is a very new vehicle, which has had not more than a half dozen launchings all-told. There are bugs in all vehicles, new vehicles, Thor had its bugs some time back.

Scout has been successful as well. I don't mean to misrepresent that.

QUESTION: Has NASA given thought to the idea that one day they will have to choose an equatorial launching site, and if so, are they studying the subject?

FRUTKIN: There has been a group in NASA since the first days of NASA's establishment, which has studied the question of launching sites. Equatorial launching sites have figured very importantly in that consideration.

I could not preclude the possibility that at some time it might be useful to use an equatorial launching site. But at the present time there is no requirement.

Do you have anything to add on this particular point?

ROTHROCK: On equatorial orbits, yes. But it may be more economical to launch from, say, Cape Canaveral, and turn the satellite into the equatorial orbit, rather than have the expense of additional launch site. It becomes largely a question of economics.

FRUTKIN: This is right. It is a most formidable expenditure to establish a new launching site.

QUESTION: Just a very small point. Presumably if you use Thor you are going to switch the launching sites from Wallops Island to Cape Canaveral.

FRUTKIN: Very likely, yes.

Am I correct, Mr. Rothrock, in saying Thor-Delta rather than Thor-Agena?

ROTHROCK: It is Thor-Delta, I believe.

QUESTION: What would be the third stage of that combination?

FRUTKIN: Can you speak to this?

ROTHROCK: It is one of the solid developments in the Vanguard.

FRUTKIN: ABL.

MISS DICK: 243?

FRUTKIN: Yes.

QUESTION: If we may look ahead two or three years, would the principle of cooperation be extended to physiological experiments being carried out by other countries in orbiting vehicles?

FRUTKIN: What do you mean? Do you mean manned flight?

QUESTION: Manned flight by someone other than an American, in an American vessel?

FRUTKIN: I see no reason to distinguish manned flight from the other programs. We are in very early stages of our own manned flight program. We have not yet orbited a man. It is pretty early to see where we are going down the long road. But there is no arbitrary exclusion of that area from a cooperative activity.

QUESTION: I think that what we have in mind is not necessarily man in space, but it was an extension of

scientific experiments to those of biological interests, whether in fact UK-1 might be switched to biological experiments.

FRUTKIN: Absolutely.

QUESTION: There is no restriction to basic sciences in a mechanical sense?

FRUTKIN: Work in the life sciences is basic science, and there is a need for group experiments in the life sciences. We should welcome group proposals from abroad.

QUESTION: You have had no proposal to put up a British mouse or rabbit?

FRUTKIN: No, we have not.

QUESTION: Is there any extent to which this has been worked in reverse, that any of our people have gone over to study with Lovell or some of the other exceptional men abroad?

FRUTKIN: We have not really gotten into this yet. The need has been fairly great in the other direction. But we would hope that this could be arranged, and that this entire matter could be considered an exchange, reciprocal exchange.

QUESTION: Two Russians have just gone to study with Lovell.

FRUTKIN: Have they? I didn't know. This is very good. Has Lovell sent anyone to the Soviet Union to study?

QUESTION: I don't think so.

QUESTION: He doesn't want to, either. He says that they haven't got anything nearly as efficient in the way of radiotelescopes to attract British scientists to Russia.

QUESTION: Would this be set up under COSPAR then if it does happen?

FRUTKIN: COSPAR specifically excludes itself from bilateral relationships. COSPAR is not an operating agency. It is a general planning and coordinating agency. It sets up broad goals which individual nations can pursue as they see fit. This is in the IGY tradition.

There is quite a distinction between the common conception of how these programs work and the way they do work.

The program that I have described, the NASA international program, is really the only program in the world at the present time which provides substantive cooperation in space research beyond the mere exchange of information.

QUESTION: Could you give me a --

FRUTKIN: Europe is preparing a program, the ESRO program -- European Space Research Organization. We welcome that. We have made very clear to Professor Massey, who is president of the Preparatory Commission for that organization, and to Professor Auger, who is the Secretary General, that we would be delighted to cooperate with ESRO on the very same

25 16
basis as we have with any individual country.

QUESTION: Could you say how many of the senior associates of the graduates are British?

FRUTKIN: I couldn't tell you how many are British, but I am certain that we can get this information for you. There certainly have been some. If you contact Miss Dick, she can get from my office the specifics.

There have been, as I recall, some 26 senior associates in this program in the little over a year that it has been in effect from a great many countries, at least 14 or 15 countries, perhaps. I am sure that the British figure in this.

QUESTION: You are running this series of communications experiments in conjunction with, among other people, the British Post Office --

FRUTKIN: Yes.

QUESTION: (Continuing) -- for the next two or three years. What will happen when they are successful? What happens after that? Presumably it goes away from NASA then, does it?

FRUTKIN: In part, in part. It is too early to say just how operational satellite communications systems will be set up. But there is a fairly well defined executive department policy now in this country. By that I mean the White House, the Federal Communications Commission, NASA, State Department, et cetera. There is a fairly well defined policy which has been formalized in a statement by the President. And this calls for pursuing the operational phase in broad collaboration with other countries.

The present notion, you know, is that a given group of companies in this country would constitute a kind of consortium. The exact limits of that consortium have not been settled. But such a group would then make arrangements in very much the same way as has been done in the past on submarine cables.

You know the UK owns the cable half way out. This pattern would be applied in some appropriate way to satellite systems. You already own your own ground terminals.

QUESTION: You would still do the launching, presumably?

FRUTKIN: Yes. The President made clear that the government would continue to provide launching. It is not presently contemplated that private companies in this country will set up their own launching facilities. So I think NASA would still be in the picture.

QUESTION: Have you anyone working on the construction of an efficient international language?

FRUTKIN: I don't think this falls quite within NASA's responsibilities. I couldn't answer that.

QUESTION: Do your plans include only the use of English in communications satellites?

FRUTKIN: I am sorry. I wouldn't want to leave that impression at all. Just exactly what it is we communicate over our systems when they are established will be worked out with the participants, the British and the French and the Germans and so on. I am sure that mutually agreeable messages will be sent. I think it is very simple to arrange various languages.

QUESTION: Simultaneous through the transmitters?

FRUTKIN: That is a technical problem. I don't know what can be done simultaneously in the early experimental satellites. But certainly we don't mean that English be the only language used. It is not on the telephone now.

QUESTION: Do you have any specific plans in NASA in connection with the International Year of the Quiet Sun, 1964 and '65?

FRUTKIN: Yes, we do. The two programs that have been suggested for space research support are the International Year of the Quiet Sun and the World Magnetic Survey.

COSPAR has now agreed to plan an international program in support of these two general geophysical programs. The United States participation will be coordinated by the National Academy of Sciences. NASA will act in support of the National Academy.

We have already begun to give consideration to specifically what programs we might conduct in this regard. You realize that NASA has a continuing program, and therefore the elements of that program are inherently a contribution to support of the two specific surveys.

The solar observatory of course will be a contribution. There will be satellites in eccentric earth orbits directed at magnetic field measurement. The sounding rocket program includes many projects which are of material value for the IQSY as well as the World Magnetic Survey. I think that there will be a rather substantial contribution. I don't think I can be more specific than that at this time.

If there are any more, perhaps one or two more, then we ought to have Mr. Rothrock go on.

Are there any more at all?

QUESTION: Mr. Fruthin, can you tell us the nine countries with which we have formal agreements on sounding rockets?

FRUTHIN: Let's say agreements, rather than formal. They are not always formal. Let's see if I can remember them.

Roy, you might help me if I slip here.

We have arrangements with Canada, which have included both the Ft. Churchill facility and specific launchings at Wallops with Canadian gear aboard; Argentina, where we have an agreement and are in the process of developing the program; Italy, where we have already had launchings; Sweden, where we have already had launchings; Norway, where we have provided some equipment and are now proposing an extension of our program; Pakistan, where we recently signed a memorandum of understanding with Pakistan and have Pakistani technicians already here in training at Wallops Island.

QUESTION: UK?

FRUTHIN: We haven't included the UK. We don't have an official relationship with the UK in sounding rocket work although we have in satellites. The question was specifically as to sounding rockets. How many have I given you?

QUESTION: Six.

QUESTION: Denmark?

FRUTKIN: Denmark is participating actually with Norway. We have not really sat down with the Danes to establish a program, but they are participating in our program with the Norwegians. So you might well include Denmark. But this is not one of the countries that I could list.

QUESTION: France?

FRUTKIN: Yes, we have an agreement with France, exactly. And Professor Blamont has been here with his very special equipment at Wallops Island, taking the data from our sodium vapor launchings and reducing it.

QUESTION: Australia?

FRUTKIN: Yes, Australia is another.

QUESTION: (Unintelligible.)

FRUTKIN: Our agreement with France looks toward satellite experiment.

QUESTION: Japan?

FRUTKIN: Yes, Japan. I am afraid this hasn't been announced publicly, but we do expect that there will be a joint program with the Japanese radio research labs in which we will launch from Wallops Island a Nike-Cajun, or a pair morning and evening, with two types of instrumentation aboard, Japanese and U.S., both designed to measure the same parameters in different ways, so that we can cross-calibrate these two.

That is nine then, is that right?

QUESTION: Yes.

FRUTKIN: With your help; thank you.

QUESTION: You did mention that the satellite programs have all been cases where you will benefit from the information gleaned by the satellites?

FRUTKIN: Rather I would say we will both benefit.

QUESTION: But you will get some benefit from it?

FRUTKIN: Yes.

QUESTION: You have embarked on a very costly moon program. Is there any part of this moon program which you think usefully could be carried out by any nation other than yourselves to help defray the cost?

FRUTKIN: This is a difficult question. The moon program has not been defined in detail here, yet, let alone in concert with any other country. It is really much too early to say.

I think we had best leave that kind of question with this statement: that we are open to specific proposals, good, hard-headed proposals from any country in any field.

I should say that in all these areas, sounding rockets, satellites, and so on, we are engaged in further discussions with additional countries for similar programs.

I think I have taken probably more time than I should have.

I want to thank you very much for your questions particularly. I enjoyed talking with you.

Mr. Rothrock?

ROTHROCK: I am going to outline with you people NASA's overall program, and I am going to do it largely on the basis of slides, most of which were prepared for Congressional hearings, some of which were prepared for my own use, some of which I borrowed from other members of the staff.

I will tell you people much that you already know. You will have to forgive me. It is partly because I don't know just how much you know of our program, and also partly because I do want to give you an integrated picture of our program.

I will go directly to the slides.

Our overall objective is, of course, the exploration in space. I have our activities in space divided into: scientific research in space; exploration in space; manned flight in space, and the development of "immediate use" satellites, which we generally term application satellites.

Scientific research in space is both the physical sciences and the life sciences. What we are doing here, of course, is continuing the investigations which man has been conducting since he first started to conduct research in the far past, except now we can put our measuring instruments outside the earth's atmosphere and either have the effect of the earth's gravitational field neutralized or remove them from the earth's gravitational field.

In the life sciences, other than support of the manned space program, we have first the investigation of the space environment on the life process; and, second, certainly one of the most exciting phases, research for extraterrestrial life.

The exploration in space is often included in the scientific research -- scientific investigations. I am referring here more to the actual placing of exploratory equipment on, first, the moon, then Mars and Venus, and then the more distant planets. First, unmanned spacecraft will land on the planets and then later the manned craft.

The manned flight in space is, of course, not an end in itself. It is only a means to an end. We do not yet know how to do this on the scale on which it should be done, so we list this as a specific category.

In the development of the "immediate use", or application satellites, the major field is the meteorological satellites and the communications satellites, either voice or television, and then also navigational satellites and geodetic surveys.

The new organization of NASA, which has just been announced, to be effective November 1, follows this outline, with these two placed in one office.

We have in addition our supporting activities, largely the development of the launch vehicles. Then the operation of the ground support systems, this is the launch system at our launch sites; and then the satellite and spacecraft tracking, command and intercommunication system at various stages around the globe.

(Slide)

In this slide we will go to the first examples of the things we have done, and then examples of the things that are in the immediate future, and some discussion of our longer range plans.

You are probably more or less familiar with this. I just take this as an example of the investigations in physical sciences. This happens to be Pioneer V. That was launched from the earth and placed in a solar orbit, in which the last message was received from it on 6-26-60, at a distance of a little better than twenty million miles from the earth.

There have been many of these craft launched, either in earth orbit, a few in solar orbit, and, of course, I would include the sounding rocket experiment in here.

(Slide)

This slide simply lists the kind of results which we have obtained: the discovery of the Van Allen radiation belts; the mapping of the geomagnetic field; the determination of the slight pear shape of the earth; a new insight into the earth's heat balance; the solar effects on the upper atmosphere; and the electron distribution in the upper ionosphere.

One thing has become evident as we perform this work. As we learn more about our spacecraft and the instruments that go into them, in general we go to larger and

spacecraft that can contain more instrumentation. I think this trend will continue for a while.

(Slide)

This slide shows the project Echo, again that you are familiar with. Now we are getting into examples of application satellites, in which the 100-foot balloon was placed into a relatively low earth orbit, and we have done certain transmitting and receiving from this in the communications field.

(Slide)

Here we have simply shown one of the pictures that was transmitted by means of the Echo spacecraft satellite. This has been given a fair amount of publicity.

(Slide)

Here we have a meteorological satellite. Most of you are familiar with TIROS I and TIROS II, in which we are taking photographs through wide-angle and narrow-angle lenses, in addition to many other measurements on heat layers, temperature, and so forth, of the earth's cloud cover.

One thing that has impressed us greatly in this field of applications is the rapidity with which results are being obtained. I think this field of activity has progressed faster than most of us thought it would when we started in the space work. The fact that the TIROS spacecraft were put up as experimental devices to more or less find out what we could about the business of weather forecasting, and the weather photographs immediately were called upon to be used in weather forecasting, this has required that we speed up the TIROS program. This speed-up of the program was covered in the address, the special message of the President to the Congress on May 25th.

(Slide)

Here we go to the kind of photographs we get with TIROS. This is TIROS I. This happens to be a weather map of the Gulf of Alaska. This is the photograph shown here and the plot as made up by the meteorologists. I am not a meteorologist, so I cannot go into this in detail myself.

We do hope to keep weather satellites up now continuously for their use in assisting in weather forecasting.

(Slide)

Here we go to the more advanced work. I have listed here the orbiting solar observatory in which we will place an observatory in a satellite, either at a more or less circular earth orbit or in a highly elliptical earth orbit, taking measurements in this case of the sun, or it could be of the various stars or from cosmic space, or we can direct the machine down -- in this case we call it an earth observatory -- toward the earth, and make measurements of the earth.

But essentially this is continuing man's general scientific investigation of the universe, of the cosmos, except with our instruments now placed outside the earth's atmosphere and going far enough beyond the various magnetic fields surrounding the earth.

(Slide)

Here we go to the Nimbus Satellite, which is an advanced meteorological satellite scheduled for launching in 1962. This is simply going one step beyond TIROS in getting useable weather information.

We work in very close conjunction with the Weather Bureau in this case. They will tell us specifically the kind of information they want to send up to us to supply the spacecraft to get the information for them.

(SLIDE)

Here we go again in advance to the active repeater satellite, also known as the relay satellite. With the Echo we bounced the beam off the satellite, simply reflected it. In this case it is received by a receiving station and retransmitted to the earth. The major difference of course is that the Echo type, the massive, is a much simpler device. It requires a much larger power station on the ground to come up here and reflect back to the receiving station.

There is more effort going into the active repeater or relay satellite currently than there is in Echo. We are continuing both, however. We don't think it is time yet to make a decision.

If these are placed in a 24-hour orbit, equatorial orbit, or near equatorial, then you have these stationary of course in relation to the earth and it makes the general guidance system simpler, although it increases the power requirements because of the distance.

This will now be roughly 24,000 miles above the earth's surface.

As in the case of the weather satellites, the communications work is coming along very rapidly, and we see practical use of the communications satellite for code and for voice and for TV. These, two, the meteorological and the communications, will be the first direct benefits to people as a whole that we will get from the space program, although navigation will play a part and so will the Geodetic Service. These will affect us more in our personal lives, of course.

(SLIDE)

Here I want to bring out something that I think is fairly important. I simply plotted here the radiant wave energy in frequency or wave length, going here from the gamma rays, X-rays, ultraviolet, visible, infra-red, TV, radar, and so forth.

These rays occur in nature or are created by man-built devices, and down here we see that the same wave lengths are carried in the cosmos.

These machines that we have been describing so far, the scientific satellites, the meteorological, the communications, navigation, geodesy, and observational, are all essentially communication spacecraft, and they receive electromagnetic radiations, either man-made or nature, and record the information in some way and transmit it to the earth, to our receiving stations. But there is no actual contact with the other planets.

In this kind of spacecraft the major effort goes on the instrumentation that is contained in the spacecraft to do these jobs. The spacecraft are generally in rather simple orbits, either elliptical, rather circular or highly elliptical, either around the earth or around the sun, or we can visualize them for one reason or another around the moon or the other planets.

From here we go to the more difficult job of landing spacecraft on first the moon and the planets, and for what we might term a more massive exploration of space.

(SLIDE.)

Here we sum up again the spacecraft used in the first type, Pioneer, the Able shots, the Discoverer shots, the Explorer shots and the communications and meteorological satellites.

On the other hand, we have what I term the second generation, although I don't like these terms too much, the Ranger, which will make a hard landing on the moon, the Surveyor, which will make a soft landing on the moon, the Prospector, which will be a larger craft and may have the ability to travel on the moon.

Then we go to the manned flight as such.

I think it is fairly important that we keep these two pictures somewhat clear.

(SLIDE.)

Now we will go more to the spacecraft. First we had the Project Mercury. You are familiar with it. I won't spend much time on it. In this our first objective is to place a man in space, and find out the manner in which he can or cannot, function adequately.

cm3

With the Russian shots of course the basic information this has required has been determined. We hope to add to it with the shots that we put up here.

(SLIDE.)

Here we have shown the trajectory of Mercury. Again you are familiar with this. The launch from Cape Canaveral, the first or half stage is dropped off, we go into orbit, the spacecraft is separated from the craft, after a given number of orbits, the retro rockets are fired, and he returns by parachute.

(SLIDE.)

Going to the next slide, we take up more of our advanced work, the search for extra-terrestrial life, in which we will want to land a life sampler on the planets and pick up indications of life and transmit this back to earth.

We hope to do this with the unmanned vehicles to precede our getting man on the planets. Our life science program currently is largely being handled through contract work and, to considerable work, in the universities. This investigation of life of course again is not new. The thesis of the effect of extra-terrestrial environments on life, life on the planets, is not new.

NASA is in a position now to finance these programs and to supply the wherewithal to get this necessary instrumentation away from earth.

(SLIDE.)

Here we go to the unmanned vehicle. This is the Project Ranger which will make a rough landing on the moon, and that will be followed by the Surveyor for a soft landing.

(SLIDE.)

Now, we will turn to the most ambitious program we are undertaking, which is the manned space flight.

In relation to this flight the President's address, that I mentioned previously, of May 25, was

extremely important because it recommended a national policy, supported by the Executive Department, recommended to the legislative, for this goal of manned flight to the moon.

The recommendations in the Message were acted upon favorably by the Congress, so this now becomes, as you gentlemen know, a national undertaking.

We have first the flight to the vicinity of the moon, and an orbiting lab manned, and then the lunar landing and exploration, and having with this a space station with men in it, and then we go to the planetary exploration.

There has been a great deal of talk as to the extent to which we need men in space. Space exploration is unique in that exploration was done with unmanned craft before we had men in them, before men were put up. So the burden of proof was why you needed men there.

This has not come up previously. It did not come up in the exploration of the earth. It did not come up in such things as the exploration that has been continued on the earth, in the various undertakings we have made.

We have always assumed, and I think correctly, that if we could get man there, it is preferable to have him there.

My own feeling is that there is no difference here. I frankly don't see too much use in arguing it too extensively. This is the kind of a thing a person either believes or does not believe as a result of his experiences, his reading, the kind of work he has been in. But I think once we get man in space, in our space stations, that we are going to find, as we have done elsewhere, that he is a very necessary part of it.

Man's mind of course, as an electronic device, is much in advance of anything that man has been able to build himself. And having the man's intellect at the site of the activity, the site of the exploration, again in my opinion is undoubtedly something we very much will need.

The present schedule is to do the moon landing, manned lunar landing, in this decade. We prefer not to be more specific than that. You people have all had sufficient experience with schedules to know that in something

of this sort we are trying to estimate how long does it take to do something we have not done before. This is not an easy thing to do.

We make a schedule to solve problems we foresee, with solutions we think we will be able to achieve. We will achieve this on such and such a date. There are always problems come up that we did not foresee.

Unfortunately we have used the word slippage to express this. It is not slippage. It is simply our lack of knowledge of the subject when we started out. Our lack of ability to accurately and precisely schedule.

(SLIDE.)

Essentially in this slide we will show the general thing that we have to do. Again you are familiar with this. We go into an earth orbit by means of a velocity of 17,000 miles an hour to put us in orbit. Then increase the velocity 7,000 miles an hour to go to the moon.

We decrease the velocity 1500 miles an hour to go into the moon orbit, 4,000 miles an hour to land on the moon, and if we repeat the steps we come in reverse order back to earth.

I don't mean to imply that we are going to do it necessarily in these steps. I do mean to imply that we need a total velocity change of 25,000 miles an hour in the vehicle.

This is from the earth orbit back to the earth orbit, I believe.

(SLIDE.)

Here we have the spacecraft as we currently see them. These have not been designed as yet. Our contracts are out for preliminary statements from the manufacturers as to this craft.

As a circumlunar flight, and by circumlunar I mean an earth orbit of sufficient eccentricity to include the moon. The craft will be relatively small. Man will be gone for an order of five days.

For an earth orbiting craft we want additional working space. This has to be done ahead of this because we must know the extent to which the men can stay up there for the required time and function normally.

For the lunar landing we take this off and go to this basic craft. We now need the propulsion system, the power plant that will slow the vehicle down to roughly 10,000 feet a second -- roughly 6,000 miles an hour -- to land on the moon from an earthescape and to accelerate from the moon back toward the earth.

So this is our general concept of the space craft.

(SLIDE.)

Here I show again the steps which we will take. First we will go into an earth orbit, and then the next step we will go into the so-called circumlunar flight, which might be direct or a figure "8." And finally the lunar landing.

What are the problems, the major unknowns we have here?

(SLIDE.)

This is a matter of the launch vehicles or boosters that are required for this program. The vehicles we have used in the program I have discussed so far are Scout, still in the development phase; Delta; Thor-Agena; Atlas-Agena; and also, I haven't shown it on here, the Redstone. The ones that are no longer here I have not shown.

Atlas-Agena will put up to the order of 4500 pounds in earth orbit. Using that as our criterion, and remembering the escape, it is roughly a third of that, if we have sufficient staging, 4500 pounds for Atlas-Agena, 1500 pounds for Thor-Agena, around 300 pounds for the Delta, in earth orbit.

Under development it is the Centaur, which will put around 8,000 pounds in earth orbit, and the Saturn C-1 which will put 19,000 pounds in earth orbit.

Saturn was started by the Von Braun school at Huntsville, with what was the largest booster we could conceive with our current engines, in this case the engines that go into the Atlas. Then as we went to the manned flight program we decided to use this in the lunar landing program, which has the name Apollo. But we found for the circumlunar flight the spacecraft required was too heavy to be put in a circumlunar flight with Saturn.

Consequently, we now are going to the so-called C-3 for the circumlunar part of the manned lunar landing. Then if we do the lunar landing with a single shot, with the so-called Nova, this vehicle has a total of 3 million pounds in the first stage -- C-3 -- and it will put of the order of 80,000 pounds in earth orbit.

Kova having eight of these same engines, or 12 million pounds in the first stage, will put around 400,000 pounds in earth orbit.

We are now in the process of deciding just what those vehicles should be for the manned program. This is a first major decision we have to make. And it is involved in do we do the manned flight with a single ascent, or do we do it with rendezvous, which will show on a subsequent slide.

In every transportation system man has built so far there has always been a maximum size which he did not go beyond. We don't know what that size is when we start out. Eventually we find it is the Queen Elizabeth, or the Queen Mary, or the U.S. United States. Or we find it is around 500,000 pounds in aircraft, or so many cars in a railroad train.

Somewhere along the line we probably have this limit here. We don't know what it is yet. But we are beginning to consider that when we add to the chemical rocketry nuclear rocketry, we are approaching this limit.

Successful achievement of rendezvous, and by rendezvous I mean meeting two spacecraft in an earth orbit or elsewhere, and then joining them, either transferring material or transferring fuel or coupling craft together, or actually building craft. Obviously if we do that we don't need as large launch vehicles.

One of the first things we have to do is decide on the size of the launch vehicles we are going to build for the space program.

(SLIDE.)

Previous slides showed liquid rockets. We also have a discussion, should we use solid rockets in the first stage, rather than the liquid, using the F-1 engine. This also is under study. It is part of our national program now to develop large solid rocket motors. This will be done by the Air Force with the motors to meet both the Department of Defense requirements and NASA requirements.

We can do this job either with a solid first stage or a liquid first stage. But we want to know, what is the quickest and what is the most economical, and in economy, I am including reliability.

So I say, one of the first problems is the size booster we need, and the extent to which we will use solids in this.

(SLIDE.)

Here I show the rendezvous slide representing rendezvous. I won't go into it in detail. If we can rendezvous in earth orbit, and say it takes 400,000 pounds spacecraft in earth orbit, this might be put up in two 200,000 pound sections, or three 150,000 pound sections, something of this sort.

Some people feel that this is a simpler way of doing it. We are going to need rendezvous anyway in our spacecraft. It has been very interesting in the last two years to see the increased interest in rendezvous in the United States.

(SLIDE.)

Here I go to the problems I thought were in ahead of the boosters, and I will take them up now. The problems immediately in the manned lunar landing, first, the re-entry. And this is coming back from the moon at parabolic velocity of the order of 25,000 miles an hour, 36,000 feet a second, and slowing down by means of atmosphere drag.

We feel that this can be done. We don't look for any undue difficulties, but we do need information which we do not now have. This means that we must send craft out and re-enter them at these velocities to see what the heat loads are.

(SLIDE.)

Here we go into the problem that does give us concern, and this is the effect of solar radiation, the solar storms. We need more information. There is disagreement as to the extent to which these flares can be foretold so that the men can come on home.

If we can get as much as three days warning on a lunar trip, they can come around and come home. We have to protect against these things, so we need much more information on solar flares, means of predicting them, and of course realizing, in talking about a lunar landing in the Seventies, we are going to run into a period of heavy solar flares.

(SLIDE.)

This represents the general business of keeping a man alive. On the lunar flight he will carry all his supplies with him. We list the input and output here.

We have the business of gravity, whether over a period of five days to a week more gravity will have any deleterious effects. We don't think it will.

So we have the problem of re-entry, the question of getting the data, the problem of gravity, its effects on man, and general support here, the question of getting the data.

On the business of solar radiations, if we have to shield, then this can cause us difficulty and also make rendezvous that much more important in achieving the mission.

(Slide)

We are going now beyond the lunar trip and looking more into the future. This is part of our requirements, long-range plans. It is always difficult to say how long into the future should one plan for. How far can we sensibly predict.

In a talk given by a chap of the Rand staff some years back, I was much impressed by his statement that engineers are as equally overly optimistic in what they can do in five years as they are underly optimistic in what they can do in twenty years. This is just the difficulty of bringing all these inputs together. As I said, the lunar landing itself is a means to an end, not an end.

We hope by the end of this decade to have a manned transportation system capable of operating within the earth-moon environment. This means we can have manned spacecraft orbiting the earth for use in our scientific work, in our communications work, in our meteorological work, and we will be ready to start the manned exploration of the moon and also to be working on vehicles for manned exploration in the more distant planets. I simply show this to give again velocities involved. For the so-called minimum energy, a total velocity change of 38,000 feet from earth's orbit to, in this case, a Mars orbit and return. This is not a landing. If I reduce that, the time taken is 970 days. This is getting up to three years, most of the time his wait on Mars, in the Mars orbit. So we will get the correct relation between Mars and the earth for return.

If I cut this down to 500 days, the velocity doubles, 38,000 feet to 77,000. This again means large launch vehicles or more rendezvous or new propulsion systems. Probably all.

(Slide)

I take this now across the gamut, and we are talking about simply general exploration, scientific investigations of the planets, and obviously when I go to Uranus, Saturn, Jupiter, and Pluto, I am not talking about manned flights, certainly any time soon. But we do want to consider what is required to put spacecraft at these planets.

I have listed two velocities. The total velocity change for a circumlunar flight, in the case of the moon, an orbit and return, a soft landing, and a landing and

return. On the others I have a probe, a fly-by, an orbit, and an orbit and return.

In each case the probes do not vary greatly, because in the probes essentially we are putting the spacecraft in a solar orbit that goes by the planet. But when we talk about orbiting and return, we talk about these very high velocity changes, 150,000 feet a second here, and 174,000 feet a second there. This is a job of the propulsion system of the spacecraft. We are not interested in distance except in relation to reliability, and if there are living things along, the supporting life. But we are interested in the velocity change.

Remember, energy goes as the square of the velocity.

So this is a kind of thing we must talk about from the standpoint of our launch vehicles and spacecraft as we explore these planets in the future.

(Slide)

This is fairly informative. I will read it off. I think you can see the curve. You won't be able to read the figures. I have here the required velocity change of the total spacecraft system. 20,000 feet, 40,000, 60,000, 80,000, 100,000, and 120,000 feet a second.

I have here the ratio of the spacecraft mass or weight at the end of the flight as it returns to earth or stops or is going to stop, in relation to the total mass of the system, launch vehicle plus spacecraft propulsion, at the start of the flight.

For instance, to put a craft in earth orbit takes around 30,000 feet a second, including losses. This means, with a completely chemical rocket with oxygen or hydrogen, I can put 10 percent of the total weight on the ground in orbit.

This happens to be a chemical rocket. This is a nuclear rocket such as Project Rover, and nuclear-electron. I will get to those.

I mentioned that Atlas would put around 10,000 -- Atlas-Centaur -- about 10,000 pounds in orbit. Its weight is of the order of 300,000 pounds. That means it is

doing around 3 percent, around here. If it were all oxygen-hydrogen it would do here.

If I go to a moon orbit, I am approaching a payload of 1 percent. Consider an aircraft with a payload of 1 percent. Transatlantic flights are of the order of 15 or 20 percent.

I come out here, with a Mars landing, and I am getting down to 1/10th of 1 percent, and finally 1/100th of 1 percent. This means if we are going to do this kind of thing we either have to have very large launch vehicles or do a lot of rendezvousing, or we must change our propulsion system.

If I go from a chemical rocket, using oxygen and hydrogen, which is about the best we can do now, to a nuclear rocket, such as Project Rover, I get out here a tenfold increase. This is why we are interested in Project Rover. The hope, of course, is to get a nuclear stage that will go on top of one of our existing launch vehicles to begin to get this improvement.

If I go to the nuclear-electron rocket, and this could be what I call the plasma jet or the ion jet -- and remember this cannot be used when you are close to planets because of the gravitational fields, because you can't launch from planets -- I would get another tenfold increase. This is why we are so interested in developing nuclear propulsion for space work.

So we can say in general here that looking into our future work we have first the development of our application satellites, and this is going to come along quite quickly; the increasing of the capability of our scientific measurements from spacecraft in earth or solar orbit, and this is something we know how to do, we can plan this fairly well. We don't say in basic research exactly what we are going to do ten years from now. It depends on what we are doing now.

Then we have the major effort which for some time to come must go to developing spacecraft systems adequate to get to the moon and the near planets; and then the distant planets, and take spacecraft sufficiently close to these planets so that we can first observe them with instruments and later, to the extent we can, observe them with men.

As I say, the heart of this is the development of nuclear propulsion.

And second, to develop equipment that can stay away from home for periods up to several years without having major repairs, or without having repairs that cannot be conducted aboard. Again I think this indicates the importance of men in the spacecraft.

(Slide)

This slide shows the nuclear propulsion system. I won't go into it. You are all familiar with it, I think, the Rover rocket with which we are conducting our work in conjunction with the AEC.

That concludes the slides. I hope I have given you a general picture of our overall program without having it in a too disjointed manner.

If there are any questions, I will be glad to answer them, or try to answer them.

QUESTION: You gave us so much. Is there any way a written copy of this could be obtained.

MAHER: There will be a written copy tomorrow about nine o'clock.

QUESTION: Thank you.

Where?

MAHER: Right here; a transcript.

QUESTION: Where?

MAHER: Room 107, the News Room.

MISS DICK: I will get some out to the IEF Press Room tomorrow afternoon, probably.

QUESTION: In discussing the question of solar flares, you suggested that it might be possible for the manned spacecraft to turn around in midstream and come back. Surely that is imposing a very high velocity penalty on it.

ROTHROCK: Yes. It is not too bad. This gets us

into another thing. We talk about man-rated launch vehicles. It is more appropriate to say a system that will protect the man in case the launch vehicle fails. This is part of that. On Mercury, of course, we have the abort system as he takes off. We will hope, on the circumlunar flight, that there will be sufficient propulsion system capacity so when he is injected into escape velocity, at that time if something goes wrong he has enough propulsion to slow him down, turn him around and bring him back. That takes about the same Delta-V it does to put him into orbit around the moon, when he gets to the moon, and come back. It works out around 3,000 feet a second. This may take a day or so getting back, but this is why I said, if we have a warning of 2-1/2 days, we think we can do it. I don't mean just a turnaround and come back.

QUESTION: And just take his chance?

ROTHROCK: Well, we would sooner not if we can take care of it.

QUESTION: Is it a scientific fact that the corpuscular radiation from the solar flares does not reach the vicinity of space for 2-1/2 days?

ROTHROCK: Will you repeat that?

QUESTION: You are giving yourself a period of 2-1/2 days' warning?

ROTHROCK: Yes.

QUESTION: My impression is that the increase in corpuscular radiation was much quicker than that.

ROTHROCK: As I said, there is disagreement on this. There have been some indications that we might do this. But I said there is disagreement on it. There is more information needed. I don't want to put too much emphasis on the 2-1/2 days. We are hoping that we will be able to get sufficient information so that the men can return. We are not sure we can do this. That is about as far as I can take it

QUESTION: This will be one of the fact-finding missions of OSO?

ROTHROCK: Yes. And a very interesting factor in laying out the lunar program, the manned lunar program, was the manner in which it brought all the work along with it. And it is particularly on these observatory kinds of things. They are much more needed now. For instance, with the unmanned lunar exploration. This all has to be accelerated if we are going to achieve this lunar landing in this decade.

QUESTION: I gather that OSO is due to be launched very shortly? The first quarter of next year?

MR. ROTHROCK: Thank you. I was not sure what the date was.

QUESTION: This method of detecting solar flares and getting advance warnings, the Russians claim to be doing this now?

ROTHROCK: Yes.

QUESTION: Have you any idea how they might be doing it?

ROTHROCK: No, I have not checked it.

QUESTION: Have you any idea how to go about it?

ROTHROCK: No, I do not, because I am not in that field. It is simply talking to the people I find that some of them think it can be done. Others are not as sanguine.

Is there anything else?

QUESTION: That life sampler, is that simply a --

ROTHROCK: Yes, as a matter of fact it is live. It was taken from a Senatorial hearing. I don't know whether you gentlemen know it, and not too many appreciate it, but the best account of the United States space program is contained in hearings before the Senate and House Committees of the Congress, in which case our people prepare statements to give to the Congressional committees that are responsible for our work.

This is different from the systems of governments that most of you people have in your countries. It is surprisingly informative, and surprisingly hard work on our part.

QUESTION: In one of those testimonials I think Abe Silverstein said that you would conduct these experiments on bringing things back at very high velocities?

ROTHEROCK: Yes.

QUESTION: Is this something which Scout is going to help with?

ROTHEROCK: Scout will be used for that, yes. You fire it up, turn it over, and then fire it back down. We had done some work of this sort in the old NACA before it was absorbed by NASA. But we will also have to go to higher specimens than Scout can fire.

QUESTION: What kind of return velocity are these likely to have?

ROTHEROCK: The parabolic will be roughly 36,000 feet a second. We are doing work at Ames currently in our shooting gallery tunnels that some of you may be familiar with, in which we shoot a small sample forward and then have a shock wave shot in the opposite direction.

We have been getting up to these velocities with samples about so big (indicating).

QUESTION: How big?

ROTHEROCK: About as big as your thumbnail, of that order in diameter. This has been described in certain of the press.

QUESTION: Again in that testimony, you said you need to develop entirely new materials. Have you any idea what kind of materials these will be?

ROTHROCK: I don't remember exactly what Silverstein said there. We are always hoping we are going to solve our problems by new materials. If someone looks at the progress that has been made, it is not always too encouraging. There have been a lot of highly intelligent well-meant men working in well-equipped labs. I don't mean that we aren't doing much, because we are doing a great deal and it will have a great impact, but we will work with however elements there are now, roughly a hundred elements. We will work with new combinations of them, of course.

In the re-entry, the thing we are going to have to do most is put the heat into so-called ablation, which again is a misuse of a word, and there are so many words we misuse.

By ablation we mean that the material is having a chemical change within it which absorbs heat and it is being melted, which absorbs heat.

With the Mercury type of re-entry, this is a means by which the heat is taken care of. That will probably be true with the Apollo.

There are other devices, of course, where you hope to come to temperature equilibrium and radiate the heat back as fast as it is absorbed. But in general, for steady temperatures, around 2,000, or with some materials say we will push up to 3,000, because this becomes very difficult.

We are doing much with materials, but progress does tend to be slow.

QUESTION: What kind of temperature do you anticipate these materials will withstand on re-entry into the atmosphere?

MR. ROTHROCK: On the whole, if it is going to be through ablation, we would sooner not run over the order -- and I am sort of guessing -- say around 2500 degrees, something of this sort. You can go to a periodic table and

plot the melting temperatures of the element against the atomic number and you pretty much know the kind of thing you can expect.

QUESTION: Surely this kind of re-entry is more or less being solved.

ROTHROCK: This is a question of experiment, because we have not worked at those energy levels. We have worked at the earth orbit re-entry but not at the parabolic escape velocity or parabolic re-entry. We do very much have this problem of how to land where you want from where you are up here. Obviously, doing it by parachute isn't too nice a way to do it. We hope we won't have to continue that too long.

QUESTION: There was mention of some kind of lifting surfaces being fitted to these Apollo craft. Would these be a sort of stubby wings that it could sprout?

ROTHROCK: It could be! This again is a point on which there is much discussion, with currently not general agreement because of lack of information.

That is, over what part of the velocity range do you want lifting elements on your vehicle? Obviously if you can come down, say, to a low supersonic velocity and then project the wings out in some way this isn't too difficult. If you have to have the wings up to hypersonic velocity, then this does become difficult. This again will have to be solved with additional applied research and development. It will be solved.

QUESTION: I would like to ask, what is the latest position as regards possible recovery of large vehicles for reuse?

ROTHROCK: I would say we will start working on it. There is study work going on now, there will be some experimental work before too long. This again is one of the things we know we are going to have to face. We know if we are going to do much transportation in space we will have to solve it. We would tend currently to put this off in lieu of some of the other problems that have to be solved first to do the job.

But there is much interest in it. Not too much money is going into it as yet.

QUESTION: Do you have a rough idea of how long a time the first American on the moon will stay there? In minutes, hours, or days?

ROTHROCK: No. We have not gotten to that point in our planning. It presumably won't be too long. Our major efforts now are first this decision on the boosters, in relation to rendezvous, and then solving the re-entry problem and the radiation protection problem and the life support.

QUESTION: Have you a specific program for rendezvous?

ROTHROCK: Those programs are being developed currently.

QUESTION: We know that the Nova project, for instance, is already being considered, and the only debateable point is whether it is liquid or solid. One hasn't heard a thing about the rendezvous program. Was it a name?

ROTHROCK: When we get to the circumlunar portion of the flight we will have to have at least the C-3, where the C-3, with the weight that is put up, that can be considered for rendezvous and landing. I don't know how many spacecraft will be involved.

The question is, do you want to do it with a single rendezvous or two or three? We have definite programs now being concocted on rendezvous. The increasing interest in rendezvous has been very great within the last certainly twenty-four months.

QUESTION: Presumably these have military applications as well?

ROTHROCK: They have what?

QUESTION: They have military implications as well?

ROTHROCK: In the same way that any transportation system has military as well as civil implications.

QUESTION: A bus stop, for instance.

ROTHROCK: Yes.

QUESTION: Presumably you would need the technique of raw materials.

ROTHROCK: I don't know how you can run any transportation system without being able to rendezvous our trucks, trains, or boats. I don't think it is any different in space than it is in transportation on the surface, the water or the air.

If we are going to adequately do things in space -- I don't care whether it is civil, military, or what it is -- we are going to have to rendezvous. To me this is simply a foregone conclusion.

QUESTION: What I am trying to get at is one part of the rendezvous technique is presumably precise positioning of

the vehicle from earth.

ROTHROCK: Yes.

QUESTION: This is necessary in anti-satellites?

ROTHROCK: You have two things: whether you are rendezvousing with another craft or whether you rendezvous to transfer people or whether you rendezvous to destroy one of them, it is again essentially the same problem. Except in one case you are rendezvousing with a craft which wants to assist you in the rendezvous. In the other case you are rendezvousing with a craft which does not want to assist you. So there are these kinds of differences.

QUESTION: Is the major difficulty at the moment the initial going from earth to rendezvous point, or the clipping together of the craft?

ROTHROCK: I would presume -- and again this is a personal opinion -- it is getting them close together, sufficiently close so you can take control immediately between the two craft, which is probably the more difficult.

QUESTION: The anti-satellite one is easy because you can hit it with a bang.

ROTHROCK: Yes. This is really a different problem as to what you do after you get close. With an anti-satellite you don't have to slow down. You want to hit him hard.

QUESTION: Is the thinking at this stage that this can be done, this sort of mating could be done automatically, or that the men will have to leave the craft in space?

ROTHROCK: I don't think we have gone that far on it. Again, I think this will simply come out through experiment.

Is there anything else?

Thank you.

I will turn the meeting back to Miss Dick.

WICK BIRM: It has been a pleasure having you with us. We will have the transcripts tomorrow, and I will get some out to the Press Room.

(Whereupon, at 3:50 p.m., the briefing was concluded.)



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FIRST LAUNCH OF SATURN (SA-1) SCHEDULED

The National Aeronautics and Space Administration is scheduled to conduct the first experimental launching of a Saturn rocket (SA-1) from Cape Canaveral, Fla., within the next several days.

The main purpose of this first launching is to test the propulsion system of the booster or first stage (S-I), verify aerodynamic and structural design of the entire vehicle, and prove the design concept and function of the ground support and launching equipment.

In this test, only the first stage will be "live." It will propel two inert upper stages (S-IV and S-V) ballasted with water to simulate the weight of live stages, and an inert payload. The vehicle will be fired over a short trajectory of about 225 statute miles range, with peak altitude of about 90 miles. Duration of the flight will be 8 minutes; maximum velocity will be 3,700 miles per hour.

The Saturn program is under the technical direction of the NASA Marshall Space Flight Center, Huntsville, Ala. The launching will be conducted by the Center's Launch Operations Directorate.

This is the first of ten research and development firings scheduled in the Saturn C-1 program. These tests are expected to lead to an operational C-1 rocket in 1964, and to an advanced Saturn shortly thereafter. The C-1 is to be used to orbit a three-man Apollo spacecraft around the earth, while the advanced Saturn is expected to take a three-man crew to lunar orbit and return, in preparation for manned lunar landings. (See "Saturn Project Background and Vehicle Fact Sheet.")

The Saturn is the world's largest known rocket. Its development has presented a multitude of unprecedented problems related to its size. Rocket technology is being extended by a considerable margin. While the development group is optimistic as to the outcome of this and subsequent tests, a new development of this magnitude is not normally carried out without temporary setbacks. Considering these circumstances, Saturn program officials think it reasonable to expect a total of five successes in the 10 research and development launchings. In this first attempt, invaluable experience and engineering data will be achieved even though the flight plan is

not completely fulfilled. Historically, rocket reliability increases proportion to the number of firings.

The first Saturn SA-1 vehicle is 162 feet in height. At lift-off it will weigh about 925,000 pounds. For early flights the eight H-1 engines in the first stage are rated at 165,000 pounds of thrust each, giving a stage thrust of 1.3 million pounds. Beginning with flight number five, the engines will have a thrust of 188,000 pounds each, or 1.5 million for the stage.

In this flight the booster will carry some 600,000 pounds of propellant, about 150,000 pounds less than the designed capacity. The inert S-IV stage, weighing about 25,000 pounds, will be ballasted with 90,000 pounds (almost 11,000 gallons) of water. The inert S-V has a stage weight of nearly 3,000 pounds, and carries 100,000 pounds (12,000 gallons) of water. The dummy payload, the nose section of a Jupiter missile, weighs slightly more than a ton.

The S-I and S-IV stages for this flight were fabricated at the Marshall Space Flight Center, and General Dynamics/Astronautics provided the S-V stage. The live S-IV stage is being developed for later flights by Douglas Aircraft Co. All stages moved from Huntsville to Cape Canaveral by water. The rocket was erected on its pad in late August. The last several weeks have been spent in checking out the vehicle and the launch facility and preparing for launch.

The launch will occur at Saturn Launch Complex 34, a multi-million dollar facility completed in June, 1961, which is being used for the first time.

(See "Saturn Launch Complex 34.")

The major objectives of the flight may be summarized as follows:

- Prove the operation of launch facilities for Saturn vehicles -- such things as propellant supply systems, ground support equipment, automatic checkout equipment, instrumentation, and launch pedestal with hold-down arms;
- Determine in-flight performance of the eight booster engines, the controlling movements of the four gimbaled engines, and engine cutoff and propellant utilization;
- Verify structural integrity of the vehicle's airframe, evaluating stress at critical moments of flight and determining vibration and bending values.

Other flight objectives are to confirm aerodynamic characteristics, correlating predicted stability and performance with that encountered in flight and to demonstrate the capability of the modified ST-90 stabilized platform in the guidance and control system.

FLIGHT SEQUENCE

The Saturn will be launched at an azimuth of 100 degrees. If all eight engines operate for the desired period, and if performance of other systems is satisfactory, the rocket will fly a distance of about 225 miles down the Atlantic Missile Range, with a peak altitude of about 90 miles. The flight would last about 8 minutes. Peak velocity, which would come at cutoff, would be about 3,700 miles per hour.

The tilt program will begin at 10 seconds after liftoff. The vehicle will continue to tilt in its flight until the 100th second is reached, when it will be inclined at 43 degrees against the launch vertical. The four inner engines will cut off at 111 seconds, and the four outer or control engines will cut off at 117 seconds. The two sets of engines are cut off in this staggered manner to prevent unacceptable oscillations which might occur if all were shutdown at the same time. Also a more complete fuel consumption is permitted by this arrangement.

The above statistics are for an "eight-engine case," that is, when all eight of the engines of the booster are operating through their normal burning periods. The Saturn, however, is to have an "engine-out" capability although that capability will not be fully realized until tail fins are added on vehicles SA-5 and beyond. As in the case of a multiengine aircraft, one engine and in some cases two will be able to cease functioning without necessarily causing a mission failure.

The engine-out capability derives from the fact that fuel and liquid-oxygen tanks have separate interchange systems at the base of the booster. In case of an engine failure these interchange systems make available to the remaining engines nearly all of the propellant which would have been consumed by the dead engine. The total booster burning time is increased to compensate for the diminished level of thrust.

The degree of the rocket's performance with one engine dead depends on which engine has failed and at what point in flight the failure occurred.

VEHICLE MEASURING PROGRAM

A total of about 610 channels of information will be telemetered from the Saturn vehicle immediately prior to and during this flight.

Of the total, 510 are so-called flight measurements, data transmitted on the many aspects of rocket performance following liftoff. Following is a list of some of the types of information to be transmitted during flight: fuel and liquid oxygen levels and flow rates, engine turbine temperature and rpm; positions of valves; temperatures of engine bearings, heat exchanger outlets, tail skirt, turbine exhaust, high pressure spheres used for pressuring fuel tanks; pressure in combustion chambers, propellant tanks, inert upper stages; strain and vibration measurements virtually all over the rocket; angle of attack and angular velocity; engine actuator positions and hydraulic oil level; stabilized platform position, velocity measurements; motion of engines, propellant level with respect to engine cutoff; and battery voltage and current, and inverter frequency.

These data will be recorded at telemetry recording stations at Complex 34 and elsewhere at Canaveral. In addition, about 100 "blockhouse" measurements will be taken during the countdown and flight. These measurements generally duplicate the most critical measurements listed above; however, the data flow directly to the Launch Control Center for the immediate observation and use by test conductors.

ENVIRONMENTAL MEASURING PROGRAM

One of the "new" problems which confront the designers of large rockets is that of sound. The Marshall Center has conducted a two-year research program at Huntsville, using scale models and later complete configurations of the Saturn booster. The object is to study the nature, intensity and transmission qualities of this type of sound to aid in the location of test and launch facilities in order to assure an adequate degree of protection for personnel and property.

The study program will continue at Canaveral with the flight of the first vehicle. In addition to acoustical measurements, vibration and blast readings will be taken.

A total of about 50 measurements of the several types will be made at and surrounding the launch complex, elsewhere on Cape Canaveral and on Merritt Island and the mainland up to a distance of about 10 miles from the launch site.

The majority of the measurements are being made by MSFC. Other organizations participating include the Air Force Missile Test Center, the USAF Aeronautical Systems Division's environmental survey team, and the U. S. Coast and Geodetic Service, the latter of which will conduct ground vibration measurements.

Extensive meteorological data will be taken for several hours in advance of the launching for correlation with results of the environmental measurements.

COUNTDOWN

The Saturn launch day countdown begins at T - 600 minutes. Following are some of the major steps in this count:

- T-600 to T-575 Open four instrument canisters at the top of the booster
- T-570 Vehicle power on to exercise electrical components
- T-510 Initial range radar and AZUSA tests
- T-350 Load 10% of liquid oxygen (about 40,000 pounds) for leak check
- T-320 Install flight batteries (vehicle remains on ground power until several minutes before launch)
- T-285 to T-210 Secure instrument canister doors
- T-270 Activate ST-90 stabilized platform in guidance system and check roll and yaw navigation commands
- T-260 Transfer to internal power for brief check of flight batteries
- T-210 Command control checks and connect unarmed destruct block
- T-130 Remove last service structure platform
- T-120 to T-75 Remove service structure
- T-80 to T-70 Clear launch pad area
- T-65 Secure launch control center
- T-60 to T-30 Complete loading liquid oxygen (replenish to lift-off)
- T-50 Pressurize various pneumatic systems
- T-6:14 Firing command and automatic sequence
- T-0:25 Retract long cable boom
- T-0 Ignition

The engines are ignited in pairs -- each pair about a tenth of a second after the previous pair. After ignition the rocket is held on its launching pedestal until proper combustion is achieved in all engines. The hold-down period normally will not exceed four seconds.

SATURN PROJECT BACKGROUND AND VEHICLE FACT SHEET

The Saturn project of the National Aeronautics and Space Administration has the objective of developing large rockets of multiple stages for the manned and unmanned exploration of space.

Saturn rockets will be capable of sending payloads of several tons into earth orbit, to the moon and into deep space. A main purpose of the project is manned space flight leading to lunar landings of men and equipment within this decade.

The Saturn development program is under the technical direction of the NASA George C. Marshall Space Flight Center, Huntsville, Ala., headed by Dr. Wernher von Braun. Hundreds of industrial contractors and suppliers are participating. The booster or first stage programs are centered at the Marshall Center; upper stages are being developed by industry.

Several versions of the rocket are planned, each more powerful than its predecessor. Saturns use conventional chemical propellants in the first stage. Early rockets will use high-energy chemical propellants in upper stages. Later Saturns may use nuclear propulsion in some upper stages, for which initial design studies are now underway.

Saturn is expected to be the major heavy vehicle for U. S. space exploration for a number of years. It is the first large rocket developed specifically for scientific space programs and manned space-flight.

BACKGROUND

As early as the spring of 1957, studies were being made by Dr. von Braun's rocket development group at Huntsville on large, cluster-engine rockets.

In the late summer of 1958, the group, then working for the U. S. Army, received authorization from DOD's Advance Research Projects Agency to proceed with design and development of a 1.5 million-pound thrust booster rocket based on the clustered engine concept. The program was specifically set up to demonstrate with captive test firings the feasibility of the clustered engine concept.

By November, 1958, the go-ahead was given to build four flight-test vehicles and to study development problems associated with reliable multi-stage Saturn vehicles. Preliminary planning for upper stages was begun.

In 1959 technical direction of the program was transferred from the Department of Defense to the National Aeronautics and Space Administration and on July 1, 1960, the Huntsville development group was

transferred to NASA's newly-established Marshall Space Flight Center.

THE SATURN VEHICLE

The first Saturn configuration, known as C-1, will consist of a maximum of three stages, S-I, S-IV and S-V. There is a 10-vehicle research and development flight test program. No more than two live stages will be flown in these 10 tests. In the first four, only the booster (S-I) will be live. In the next two, the booster and the second stage (S-IV) will be live. While the primary purpose of the first 10 flights is to prove the vehicle, the last four flights, SA-7 through SA-10-- also with two stages -- will have secondary missions of testing early models of the Apollo spacecraft.

Initially it was planned to use three live stages in the last four of these 10 C-1 flights. Two recent changes in the program, however, will permit the accomplishment of the Apollo missions using a two-stage rocket: 1) the thrust of the S-IV stage was increased from 70,000 pounds to 90,000 pounds by the addition of two engines, and 2) the propellant capacity of the S-I is to be increased beginning with the fifth flight.

On the first four flights, with inert S-IV and S-V stages, the vehicle will be about 162 feet high. For the next two flights, in which the S-IV will be live, an extended payload adapter-instrument compartment will compensate for the deletion of the S-V, providing a vehicle of approximately the same height. Beginning with flight number seven, the vehicle, with Apollo spacecraft, will be about 170 feet in height. Also beginning with flight five, aerodynamic fins will be added at the booster's tail section. Elimination of the S-V stage in these flights lowers the rocket's center of gravity, which makes the fins desirable. But the main reason for adding fins is to give the Saturn a capability for a broadly-varied mission in the future.

In the first flights using inert upper stages ballasted with water, the C-1 configuration will weigh about 925,000 pounds at liftoff. In later flights using Apollo hardware as payload, the C-1 will weigh 1,100,000 pounds.

Advanced configurations of Saturn are under intensive study by NASA. Plans call for the first stage or booster (S-IB) of advanced Saturns to be powered by two or more 1,500,000 pound thrust F-1 engines.

Following are descriptions of the Saturn stages:

S-I: The Saturn C-1 first stage (S-I) is powered by a cluster of eight Rocketdyne H-1 engines, each of which will ultimately produce 188,000 pounds of thrust to give a total of 1,500,000 pounds, equivalent to a maximum of 32,000,000 horsepower. The H-1's in the SA-1 launch are rated at 165,000 pounds thrust each.

The H-1 engine, an advanced and compact offspring of the Jupiter and Thor engine, was selected because of its relative simplicity, early availability, and proven reliability. It burns RP-1 (kerosene) fuel and liquid oxygen. Major changes incorporated in the H-1 include a

simplified start sequence using a solid propellant gas generator, and location of the turbopump on the thrust chamber, below the gimbal block, so that the flexible propellant feed lines to the engine need only carry low pressure propellant.

The eight H-1 engines are attached to an eight-legged thrust frame on the aft end of the vehicle and arranged in two square patterns. The four inboard engines are rigidly attached and canted at a three-degree angle to the long axis of the booster. The outboard engines are canted at an angle of 6 degrees and mounted on gimbals which permit them to be turned through angles of up to $7\frac{1}{2}$ degrees to provide control of the vehicle during first stage powered flight.

Nine separate tanks feed the eight H-1 engines. Clustered in a circle about a large center tank of 105 inches in diameter are eight smaller tanks, each 70 inches in diameter. The center tank and four outer ones contain liquid oxygen, while the remaining four outer tanks carry the kerosene fuel. The fuel containers are pressurized by gaseous nitrogen carried in 48 fiberglass spheres atop the tanks, and the liquid oxygen containers are pressurized by gaseous oxygen obtained by passing liquid oxygen through heat exchangers that are part of each engine package.

The fuel tanks as well as those containing liquid oxygen are interconnected at the base to allow the maintenance of equal levels in all tanks during burning. In case one engine malfunctions and is cut off during flight this arrangement permits the remaining seven engines to consume the fuel and oxygen intended for the dead engine. Thus, the burning time of the seven remaining engines is increased and there is little loss in overall booster performance.

The nine propellant tanks are attached at the top by an eight-legged spider beam.

One test model and the flight SA-1 booster have been successfully static fired some 20 times including several full duration runs of about 120 seconds.

The first ten Saturn flight boosters are being produced at MSFC. Later ones will be produced by a contractor now in process of selection at NASA's large rocket assembly plant being established at the Michoud Ordnance Plant, New Orleans, La.

Likewise, S-IB boosters will be built at the Michoud plant. Proposals for the S-I contract were due to be received on October 16. Requests for quotations were available to industry on the S-IB stage on October 7 and proposals are to be submitted by November 8.

S-IV: The S-IV, which is the second stage of the C-1 vehicle, will be powered by six 15,000 pound thrust Pratt and Whitney liquid hydrogen-liquid oxygen engines, known as the RL-10.

The S-IV is 18 feet in diameter and about 40 feet in length. Its development was begun some 15 months ago by the Douglas Aircraft Company in Santa Monica, Calif.

Development of the S-IV includes an interstage structure which provides space for the six engines and transmits the load from the upper part of the rocket to the support points on the stage beneath. This structure will remain with the lower stage upon separation in flight.

The mid-portion of the S-IV is primarily an aluminum cylindrical container composed of the aft liquid-oxygen tank and the larger forward liquid-hydrogen tank.

Attached to the cylindrical section are small rockets to be used in separation of the S-IV from the stage beneath. At the forward end of the cylindrical container is the structural assembly or forward adapter which will provide support for a spacecraft or S-V stage. Retrorockets for separation of the S-IV and S-V are mounted on this adapter.

S-V: The S-V, which will be the third stage for some later C-1 operational flights, will be a Centaur modified for use on Saturn. This stage uses two RL-10 engines of the type employed in the S-IV.

The basic pressurized stainless steel structure of Centaur will be used as well as most of the basic components developed by General Dynamics/Astronautics Division at San Diego for the Atlas-Centaur. One exception is the fact that skin thickness must be increased to accommodate the heavier payloads of the Saturn vehicle. The S-V is 10 feet in diameter and 29 feet tall.

S-V modification design studies are presently being conducted by General Dynamics.

GUIDANCE AND CONTROL

The initial Saturn guidance and control system will be primarily an adaption of Jupiter system components to meet Saturn requirements. One significant departure will be the addition of rate gyros as sensing elements. Structural bending of the large and relatively flexible Saturn requires the consideration of rate gyros for stabilization.

Saturn will use all-inertial guidance. More advanced hardware will be introduced into the system as the guidance missions become more demanding. Object of the guidance scheme is to provide a universal system that is capable of performing a variety of mission requirements placed on the vehicle to meet payload objectives. This universal guidance concept will allow a variety of requirements with a minimum of changes.

Heart of the final guidance scheme is a high-speed digital computer incorporating advanced techniques of design and packaging and capable of meeting Saturn's high reliability standards and difficult missions in terms of programming.

For S-I, for example, the guidance system will automatically give corrective signals necessary to compensate for deviations resulting from loss of thrust should one of the eight H-1 engines fail to perform properly.

SATURN C-1 LAUNCH SCHEDULE

Vehicle Description	Launchings per Calendar Year			
	1961	1962	1963	1964
R&D, S-I with inert upper stages and simulated payload	1	2	1	
R&D, S-I, S-IV with simulated payload			2	
R&D, S-I, S-IV with boilerplate Apollo payload			2	2

SATURN MISSIONS

The two-stage Saturn C-1 vehicle will be capable of placing a payload about 20,000 pounds in low orbit.

One advanced three-stage configuration, by comparison, will be able to place more than 80,000 pounds in low earth orbit, send 30,000 pounds to escape velocity, or 20,000 pounds on a Mars or Venus probe.

Major early uses of Saturn vehicles will be in connection with manned space exploration. The two-stage C-1 will be used to place Apollo spacecraft, carrying three men, into earth orbit of up to two weeks duration. An advanced version will send a later model of the same three-man spacecraft to a moon orbit and return. These two steps are in preparation for a manned lunar landing, which will be accomplished using a still larger vehicle (Nova) in a direct flight, or with Saturn rockets employed in earth orbital rendezvous.

Other possible uses of Saturn include launching of soft-landing stationary or roving payloads of instruments on the moon, probes to Venus and Mars, and 24-hour communication satellites. The Saturn may also be used for other manned earth orbital experiments, and as a carrier vehicle for nuclear propulsion tests.

TRANSPORTATION

Because of its size, transportation of the S-I from Huntsville to Cape Canaveral poses a unique problem. It is too large to be moved by conventional rail, highway or air transport. As a result two barges are used to transport the S-I. The route includes the Tennessee, Ohio and Mississippi rivers, the Gulf of Mexico, and intercoastal waterways to Cape Canaveral on the east coast of Florida. The distance is more than 2,000 miles.

The S-IV stage is planned to be shipped by water from its point of manufacture on the West Coast to Cape Canaveral, via the Panama Canal. Possible air transportation of the S-IV is being studied.

The S-V, 10 feet in diameter, can be transported conventionally by aircraft.

CONSTRUCTION

Saturn's immense size necessitated the construction of new development, testing and launching facilities. Among the projects at the Marshall Center in Huntsville was modification of the captive test stand to accommodate the S-I, the addition of a dynamic test stand for assembled Saturn vehicles, and the construction of a second captive test tower is now underway.

At Cape Canaveral, where the Center's Launch Operations Directorate will launch the rocket, several major construction projects are in progress. A Saturn launch complex, including blockhouse, launch pad and a service structure, was completed in June, 1961. A contract to construct another complex was awarded in September, 1961. Both of these are for Saturn C-1 rockets.

Advanced Saturns will be launched from a major new area north of the present Canaveral facilities, land acquisition for which is expected to begin shortly.

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-140-

SATURN LAUNCH COMPLEX 34

The Saturn heavy space vehicle will be fired at Cape Canaveral from the largest known rocket launching site -- and the first such large base built especially for the peaceful exploration of space.

The massive site has been designated as "Launch Complex 34" and is located on 45 acres of land. The, multimillion dollar facility was completed in June.

Construction of the complex was accomplished for the National Aeronautics and Space Administration under the direction of the Jacksonville (Fla.) District of the U. S. Army Corps of Engineers.

Major industrial contractors were Diversified Builders, Inc. of Montebello, Calif., for the Launch Control Center; Kaiser Steel Corporation's Fabricating Division, Montebello, Calif., for design and construction of the service tower; and Henry C. Beck Co. of Palm Beach, Fla., for the launch stand and appurtenant facilities.

Launch Operations Directorate, a part of the George C. Marshall Space Flight Center, Huntsville, Ala., drew up the general criteria from which the facility was constructed. Dr. Kurt H. Debus, who heads LOD, directed the installation of ground support equipment. His organization will conduct launchings from the complex.

Although unintended, the word "complex" is a fortunate name for the facility. It is complex, and big. Here is a thumbnail sketch.

* A 45-acre installation, dominated by a movable structure 310 feet high and weighing 2,800 tons.

* A Launch Control Center with walls 12-feet thick having a steel door two feet thick which weighs 23 tons.

* Efficient fuel and liquid oxygen storage facilities which are capable of pumping 750,000 pounds of fluid into the big booster in approximately an hour.

* A launching pedestal foundation reinforced by 4,400 cubic yards of concrete and 580 tons of steel.

* A total of 100 million pounds of concrete used in construction.

* A unique Automatic Ground Control Station, a room 38 feet wide by 215 feet long, located beneath the concrete and steel launching pad.

FUTURE LAUNCH FACILITIES

About a mile north of Complex 34 is the site where NASA's new complex, designated 37, will be constructed. A \$15 million contract for initial work on it has been awarded. Scheduled for first-phase completion late in 1962, this new complex will eventually have two launch pads, served by a common, rail-mounted tower.

Farther north of 34 is the site of projected NASA expansion which will permit the construction and operation of six or more large Saturn and Nova-class launch vehicle complexes.

NASA has announced plans for the acquisition of some 80,000 acres for this expansion which covers lands north and west of present Cape facilities.

The planned complexes will be a base for manned lunar flights and other missions requiring advanced Saturn and Nova-class boosters.

MAJOR ELEMENTS OF COMPLEX 34

Service Structure -- The service structure is 310 feet tall. It has twin legs measuring 70 feet by 37 feet at the base. The center opening, in which the rocket is situated during checkout, is 56 feet wide.

Each of the legs contains a two-floor building which houses the structure's operating equipment and rocket checkout apparatus. A huge bridge crane of 60-ton capacity is on the structure to erect the rocket on the launching pedestal.

Said to be the world's largest movable wheeled structure, the tower is mounted on two pairs of standard-gage heavy railroad tracks. The tower can be controlled by a single operator, situated in a cab at the 27-foot level. The tower is capable of moving from 1-1/2 to 40 feet per minute.

After the checkout of the rocket is completed, the service structure is moved to a parking area -- the position it occupies at launch -- some 600 feet from the launch pedestal.

Launch Center -- The Saturn control building is very similar to the blockhouses built at Canaveral for Titan and Atlas missiles. It has 10,000 feet of protected floor space on two levels and an additional 2,150 square feet of unprotected space in an equipment room which will not be occupied during launchings.

The first floor of the building is to be used by booster and upper stages contractor personnel involved in tracking and telemetry operations.

The main firing operation will be located on the second floor. Equipment includes firing console, test supervision and conductor consoles and various monitoring and recording panels. A small observation room is separated by glass from the operating area. Pre-launch activities in the area can be viewed from an observation balcony on top of the building.

Launch Pad -- The launch pad, constructed of reinforced concrete, is 438 feet in diameter and eight inches thick. Special foundations have been provided for the service structure and the launch pedestal.

Pedestal -- The pedestal is located in the center of the launch pad. It is 42 feet square and 27 feet high. The pedestal foundation contains 4,400 cubic yards of concrete and 580 tons of steel. Its depth varies from eight feet at the center to four feet at the edges.

Bolted to a ring at the top of the pedestal are eight arms. Four are support arms and the other four both support the rocket and restrain it from liftoff until the proper burning condition has been achieved by all eight Saturn engines.

Deflector -- Beneath the launch pedestal is a rail-mounted flame deflector. This steel structure diverts the 5,000 degree F. jetstream in two, opposite horizontal directions. A spare deflector is parked on a spur track on the same side of the pedestal.

Umbilical Tower -- Adjacent to the launch pedestal is the umbilical tower, the main function of which is to provide electrical, hydraulic and pneumatic lines to the rocket. At present the tower is only 27 feet tall, but will be increased in height as live upper stages are added to the rocket.

Automatic Ground Control Station -- A room known as the automatic ground control station is located immediately beneath a major portion of the pad. It serves as a distribution point for all measuring and checkout equipment, power and high pressure gas. It is not occupied during launching.

Fuel System -- RP-1 fuel (kerosene) is provided to the booster from two above-ground tanks located about 950 feet from the launch pedestal. The tanks have a capacity of 30,000 gallons each. Unlike many fueling operations, this one is completely automated, being operated from the control building. Normally, the booster will be fueled in about 40 minutes.

Liquid Oxygen System -- There are two liquid oxygen (LOX) storage tanks some 650 feet from the launch pedestal, well removed from the fuel facility. A six-inch line feeds the rocket at a flow rate of up to 2,500 gallons per minute. It will take about 40 minutes to fill the Saturn booster's five LOX tanks, which hold an estimated seven tank car loads.

High Pressure Gas Facility -- There are several uses of gaseous nitrogen and helium in the preparation and firing of the Saturn. A high-pressure gas facility is located about 1,100 feet from the launch pad. There are 36 storage vessels divided into two groups. Four contain helium used for bubbling the LOX tanks of the booster. Thirty-two contain nitrogen which is used for purging fuel and LOX lines, engine and instrument compartments, for air bearings and for certain pressure-operated components such as valves.

Skimming Basin -- A skimming basin is located about 300 feet from the edge of the pad on the beach side. This vat is used to collect fuel which might be spilled on the pad, thus preventing it from entering normal Cape drainage canals.

Water Systems -- A water system has been installed on the pad and throughout the service structure, primarily as a safety measure. Water is available at all work levels on the tower for fire protection. There is a quenching system for use in case fire occurs accidentally in the "boattail" or engine compartment; this system is also used to extinguish flame in the engine compartment in case the engines are cut off immediately after ignition and before liftoff.

Operation Support Building -- On the opposite side of the control building from the launch area is an operations support building which will be used for general shop and engineering activities in direct support of launch operations.

Communication System -- A voice communications system is being installed by the Launch Operations Directorate. The system consists of about 200 stations scattered throughout the 45-acre installation.

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THE TEAM BEHIND SATURN

The development of the Saturn space vehicle system is a joint effort of government agencies and private industry under direction of the National Aeronautics and Space Administration.

At NASA Headquarters, Washington, the Director of the Office of Launch Vehicle Programs is Thomas F. Dixon. Effective November 1, under the recently-announced reorganization of NASA, Headquarters responsibility for Saturn development will be in the Office of Manned Space Flight Programs.

Saturn project manager for NASA is Richard B. Canright who has been associated with Saturn since its inception. Canright was chairman of the Vehicle Panel of DOD's Advanced Research Projects Agency which in mid-1958 authorized design and development of the eight-engine Saturn booster. Headquarters direction of Saturn launch operations is by Samuel Snyder.

The Saturn development program is under technical direction of the George C. Marshall Space Flight Center at Huntsville, Ala. Dr. Wernher von Braun is director. Deputy director for research and development is Dr. Eberhard F. M. Rees and Harry H. Gorman is acting deputy director for administration.

Director of MSFC's Saturn Systems Office is Dr. Oswald H. Lange.

Other technical offices and research and development divisions supporting Saturn development and their directors are: Aeroballistics, Dr. Ernst D. Geissler; Computation, Helmut Hoelzer; Fabrication and Assembly Engineering, Werner Kuers (acting); Future Projects, Heinz H. Koelle; Guidance and Control, Dr. Walter Haeussermann; Light and Medium Vehicles, Hans Hueter; Lunar Program Planning, Hans H. Maus; Research Projects, Dr. Ernst Stuhlinger; Structures and Mechanics, William A. Mrazek; Quality, Dieter Grau; Test, Karl L. Heimborg; and Launch Operations Directorate, Dr. Kurt H. Debus.

Dr. Debus will direct launch activities for SA-1. His deputy is Dr. Hans F. Gruene. Albert Zeiler is chief of the mechanical office and Carl Sendler is chief of measurements and tracking. Test supervisor is Robert Moser and Maj. Rocco Petrone is chief of Saturn project office.

The Marshall Center, whose personnel developed and launched the Jupiter C, Juno II and Mercury-Redstone rockets, is fabricating and assembling the first ten Saturn test-flight boosters, the four inert second (S-IV) stages and conducting related research throughout the program.

Some 80 per cent of the Center's Saturn budget, however, is going directly to private industry and other government agencies. And, much of the remaining 20 per cent is awarded outside of NASA to other government agencies for various technical and administrative support.

During the period of July 1, 1960 (the date on which the Saturn program was officially transferred to NASA from the Army) to August 30, 1961, 17 organizations have each received contracts totaling \$500,000 or more in connection with the Saturn program.

These major contractors, the dollar amount received and a brief description of the services or goods contracted for are listed alphabetically as follows:

Air Research and Development Command, Andrews Air Force Base, Washington, D. C., \$12,655,000 for administration of funds in the development of a liquid hydrogen-liquid oxygen engine, preliminary design studies of the Saturn S-V stage, and procurement of rocket propellant;

Arnold Engineering Development Center, Tullahoma, Tenn., \$683,263 for study of base heating effects of altitude, engine gimbaling and other flight conditions, and for providing wind tunnel test time;

Avco Corp., Cincinnati, Ohio, \$562,794 for developing data transmitter components, fabricating structural components, developing ground equipment to separate sampled data transmitted from Saturn, and testing radio guidance equipment in vehicle;

The Bendix Corp., Detroit, Mich., \$539,495 for development and fabrication of liquid level gage for Saturn container tanks, vehicle stage separation indicator, guidance and control system components and high-pressure spheres for pressurizing Saturn fuel tanks in flight;

Brown Engineering Co., Huntsville, Ala., \$6,222,665 for trained engineering personnel assigned to various design and research projects on the Saturn program, and fabrication of optical and weight-measuring tooling for aligning and determining the center of gravity and mass moments of inertia of the vehicle;

Chrysler Corp., Detroit, Mich., \$14,175,871 for fabrication of structural components for early Saturn payload units, investigation of deterioration of lubricants, analysis of structural materials, tests of engine and vehicle components, and services of trained engineering personnel;

Douglas Aircraft Co., Santa Monica, Calif., \$29,500,169 for development of the 90,000-pound-thrust Saturn S-IV stage, which will be employed as the second stage of the Saturn C-1 configuration.

Flexonics Corp., Calumet and Hecla, Inc., Maywood, Ill., \$2,974,162 for engineering, fabrication and testing propellant vent, pressurization and feed lines for Saturn booster;

Hayes Aircraft Corp., Birmingham, Ala., \$10,388,441 for use of trained engineering personnel, design and manufacture of Saturn fabrication tooling and test equipment, and test and checkout of ground support equipment at Saturn launch facility, Cape Canaveral;

Lockheed Aircraft Corp., Marietta, Ga., \$1,876,755 for fabrication of major components in Saturn tail section, precision tooling for assembling booster flame shield and pressure and functional checkout equipment for booster;

Minneapolis Honeywell Regulator Co., Minneapolis, Minn., \$866,120 for adapting existing guidance package to meet Saturn requirements, studying control and dynamic stability characteristics of Saturn vehicle, and providing gyros, accelerometers and related instrumentation;

North American Aviation, Inc., Los Angeles, Calif., \$58,627,128 for development by Rocketdyne Division of Saturn H-1 and J-2 engines, fabrication by Space and Information Systems Division of Saturn inter-stage fairings and liquid oxygen valve assemblies, and studies of Saturn recovery system and future vehicle concepts;

Pratt and Whitney Division of United Aircraft, West Palm Beach, Fla., \$18,070,820 for development of liquid oxygen-liquid hydrogen RL-10 engines for Saturn upper stages;

Progressive Welder and Machine Co., Pontiac, Mich., \$885,230 for fabrication of booster assembly fixtures and various drill and weld fixtures for booster;

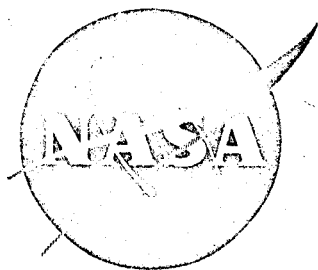
Redstone Machine and Tool Corp., Huntsville, Ala., \$711,790 for manufacturing of precision test fixtures, fabrication and assembly tooling and large scaffolding;

Spaco Manufacturing Co., Inc., Huntsville, Ala., \$806,870 for manufacturing electrical components and furnishing electrical wiring used in final systems checkout of Saturn first stages, and furnishing sheet metal work for booster fabrication;

U. S. Army Corps of Engineers, Jacksonville, Fla., Mobile, Ala., and New Orleans, La., \$27,111,415 for construction of Saturn Launch Complexes 34 and 37 and related facilities at Cape Canaveral, Fla., excavation for static test stand at Huntsville, topographic surveys of land, dredging of Saturn barge turning basin and unloading slip and construction of mooring facilities at Cape Canaveral.

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"The Chicago Society was a splendid demonstration of the strength of our national spirit for peace and an effective collaboration with the leaders of our national economy for peaceful heavy industries promising to make up the program suggested by President Kennedy on May 1961. He is still deeply appreciable the contribution by our railway services and American industry in achieving this important collection. I have already expressed my appreciation to Mr. Kennedy and Nixon and Mr. Earl Warren for the role of their two groups in this."



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: AM's Saturday
October 7, 1961

RELEASE NO. 61-222

NASA REQUESTS PROPOSALS ON SATURN S-IB STAGE

The National Aeronautics and Space Administration today invited 27 firms to submit proposals for the position of prime contractor on an advanced Saturn booster stage, S-IB.

Detailed documents spelling out the scope of the work were made available to the firms by NASA's Marshall Space Flight Center, Huntsville, Ala. No preproposal conference is planned.

The S-IB will be the world's largest known rocket unit. It will have at least three million pounds of thrust -- double that of the present Saturn S-I booster. The unit is to become the first stage of an advanced Saturn rocket slated for use in the nation's program of manned lunar exploration.

Plans call for the S-IB to be powered by two or more F-1 kerosene/liquid oxygen engines each developing 1.5 million pounds thrust.

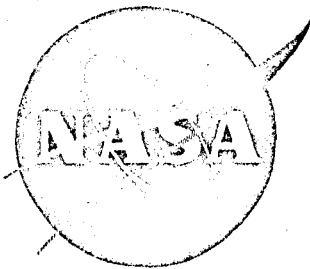
The companies will have until November 8 to submit their proposals to Marshall. Evaluation will then follow with resulting recommendations to be made to the NASA Administrator so that a firm can be selected in December.

The chosen contractor will participate in the design and development of the vehicle and will perform production and testing.

The booster is to be produced at NASA's new Saturn launch vehicle assembly plant, New Orleans, the former Michoud Ordnance Plant which will be reactivated shortly. The initial Saturn S-I booster also will be produced at the New Orleans plant.

NASA invited as potential offerers all firms that obtained requests for quotations on the S-I contract. An S-I preproposal conference was held at New Orleans September 26 and bids on that project are due October 16.

- END -



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 3-3222 EXECUTIVE 3-3260

FOR RELEASE: SUNDAY AM 8

October 8, 1961

DO NOT REMOVE

RELEASE NO. 61-223

SYNCOM DESIGN AND OPERATION

Design of the SYNCOM communication satellite is nearly complete, the National Aeronautics and Space Administration announced today in disclosing preliminary details of the satellite's construction and operation.

SYNCOM is an experimental active repeater communication satellite to be placed in a 24-hour orbit. It is to be launched from the Atlantic Missile Range at Cape Canaveral, Fla. in late 1962. SYNCOM will be used to relay telephone and telegraph communications over near Hemispheric distances. Early SYNCOM will not have the capability to relay television signals.

These are some of the details on SYNCOM:

It will be cylindrical, 25 inches high, 28 inches in diameter, and weigh about 55 pounds, excluding an attached solid propellant rocket motor. This motor, called the apogee motor, will be used to inject the spacecraft into a circular near-synchronous orbit when the SYNCOM reaches apogee (22,300 miles) of the trajectory into which it is boosted by the three stage Delta vehicle. In addition, 10 small vernier rockets will be used to further correct the final velocity. Two nitrogen jets, will be employed to attain and maintain required orientation and position. One jet is located on one end of the spacecraft about 12 inches to one side and thrusts paralleled with the spin axis. The other jet is located in the side of the cylinder, and thrusts perpendicular to the spin axis. Solar sensing cells, located on the side of the cylinder, provide information via telemetry, in real time, from which necessary adjustments in orbiting and orienting the satellite will be made by command from the ground.

The cylindrical shell will carry an array of 3960 solar cells to supply power and charge nickel-cadmium batteries which will power the satellite's instrumentation when it is not in sunlight. The system is designed to give the SYNCOM a "working" lifetime of one year, supplying 20 watts of power at 27.5 volts.

There are duplicate telemetry and communication systems (including command systems). This is to provide a "spare" in event one system does not operate properly. The communications system operates on a power of 2 watts.

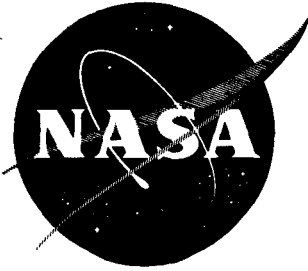
The satellite will have two antenna systems. A slotted array antenna projecting from one end of the spacecraft, will receive and transmit the telephone and telegraph communications. Telemetry will be transmitted via four whip antennas. These are attached at the opposite end of the spacecraft, projecting outward 90 degrees apart in turnstile fashion.

Communications signals, telephone and telegraph, will be sent to the SYNCOM on a frequency of 7500 mc. The signal will be amplified by a lightweight traveling wave tube and retransmitted to the ground on 1850 mc. Telemetry will be transmitted on 136 mc. In addition to relaying "real time" data on the attitude of the satellite, information will be telemetered relating to the solar cells, the communication systems, jet reaction system, and spacecraft temperature.

The SYNCOM will be stabilized in orbit by spinning it like a gyroscope. Its spin axis will be perpendicular to the plane of its orbit and generally will be North-South in relation to the Earth. Spinning, with the cylindrical part of the spacecraft always facing Earth, the satellite will transmit a circular beam -- somewhat pancake in shape -- with its "edge" always toward the earth.

SYNCOM will be placed in a 22,300-mile orbit synchronous with the rotation of earth. The first series of SYNCOM satellites will not be in stationary orbits, but will move in an elongated figure 8 pattern 33 degrees north and south of the equator over a given longitude over the Atlantic Ocean during its 24 hour period. To achieve this orbit, properly orient the satellite, and maintain its attitude, a special control system will be employed which was developed by the Hughes Aircraft Company for a lightweight spacecraft.

The SYNCOM control system will be employed after the Delta has spun up to about 160 rpm and boosted the spacecraft to synchronous altitude. As presently programmed, this should occur off the southeast coast of Africa about $5\frac{1}{2}$ hours after launch. The apogee rocket motor in the satellite then will be fired to give the vehicle sufficient velocity to place it in a nearly circular synchronous orbit.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: A.M.'s

Tuesday, October 17, 1961

RELEASE NO. 61-224

RANGER 2 TO BE LAUNCHED

Ranger 2 will be launched by the National Aeronautics and Space Administration at Cape Canaveral, Fla., within a few days. It will be the second launching in the Ranger Series. Ranger I was launched from AMR on August 23 and placed in a low earth orbit. Although the flight was made in an environment for which the spacecraft was not designed, it provided a good test of many spacecraft subsystems.

Both Ranger I and 2 are designed to develop and test basic spacecraft technology required for lunar and planetary missions. These include an attitude stabilization system based on celestial references (the sun and earth), a high-gain pointable antenna, an advanced communication system, the development of components able to operate for long periods in a space environment, and the calibration of solar cells in a space environment.

Ranger 2, like Ranger I, will carry many important scientific experiments designed to study the nature and activity of cosmic rays, magnetic fields, and radiation and dust particles in space, along with an experiment which seeks to discover if the earth carries along with it a comet-like tail of hydrogen gas.

Eight scientific experiments are carried on Ranger 2. They are the work of scientists and engineers at the California Institute of Technology, Goddard Space Flight Center, Jet Propulsion Laboratory, Los Alamos Scientific Laboratory, Naval Research Laboratory, State University of Iowa, and the University of Chicago.

The Ranger project is part of the National Aeronautics and Space Administration program to explore the moon and the planets. The Jet Propulsion Laboratory, operated for the NASA by Caltech, developed the Ranger spacecraft and is responsible for the execution of current projects in the unmanned part of this program.

The Ranger project is divided into three phases. The first phase is the development and testing of the spacecraft technology by Rangers I and 2. Like Ranger I, Ranger 2 will not be aimed

at the moon but will be sent off on a long trajectory into space, reaching more than half a million miles from earth before it returns to earth's atmosphere and burns up after a round trip of perhaps more than 50 days.

The second phase of the Ranger project will start early next year and will include three Ranger spacecraft designed to place an instrumented capsule on the moon to measure and report to earth on the presence, or absence, of moon quakes. These Rangers also will take television pictures of the moon.

In the third phase of the project, four Rangers will carry high-resolution television cameras designed to send back to earth fine-grain TV pictures of the lunar surface right up to the moment of impact.

SPACECRAFT DESCRIPTION

Ranger 2 is slightly more than five feet in diameter at the base of the hexagon and 11 feet long. In its cruise position, with its solar panels extended to collect energy from the sun, it is 17 feet in span and 13 feet long. Ranger 2 weighs 675 pounds, of which 261 is represented by the electronics, 121 is the scientific experiments, 50 is the solar panels, 125 is structure, and 118 is launch-backup battery.

Rising from the hexagonal base are four struts and four diagonal braces made of aluminum which serve to support the scientific instrumentation. Ranger 2 has two radio transmitters and two antennas, one an omnidirectional antenna at the front end of the spacecraft, and the second a high-gain directional antenna 4 feet in diameter at the base of the spacecraft, which will be aimed at the earth in order to permit more efficient transmission of data after Ranger 2 is well out in space.

The solar panels are each approximately 10 square feet, and each contains 4340 solar cells to collect sun energy, making a total of 8680 solar cells on the two panels. They are expected to pick up enough solar energy to be converted into a minimum of 155 watts and a maximum of 210 watts.

Because of the attenuation of solar energy by the earth's atmosphere, there is uncertainty as to precisely how much solar energy can be collected by the panels and converted into electrical energy. This uncertainty must be resolved before more complicated spacecraft carrying solar panels are sent out on different missions, some as far as Venus and Mars, so one of the experiments on board Ranger 2 includes four specially calibrated solar cells which will measure the characteristics of solar cells operating in a space environment.

The two solar panels are hinged on framework below the hexagon, and in the launch position are carried folded in the manner of butterfly wings.

In the hollowed-out inner section of the hexagon is a silver zinc battery weighing 118 pounds with a capacity of 9000 watt hours. This battery will provide the power to run the spacecraft prior to the time of acquisition of the sun by the solar panels, and also, will serve as a backup power source if the solar acquisition is not successful. The battery will provide enough electrical power to run the spacecraft for two days.

The two radio transmitters on board will both send data to earth via the omnidirectional antenna initially. A three-watt transmitter will send on a frequency near 960 megacycles, and a separate quarter-watt transmitter will send on a similar frequency, the three-watt transmitter shifting to the directional antenna after earth acquisition. The quarter-watt transmitter has a lifetime of seven days and will stay on the air continuously until its battery is exhausted.

SPACECRAFT CONTROLLER

Six boxes located on each side of the hexagonal base contain the electronic intelligence of Ranger 2. One of the most important of these instruments is called the spacecraft controller. It is this controller which tells Ranger to calculate electronically when it should perform what function, when it should roll and pitch to find the sun and lock onto this power source with its solar panels, when to find the earth and aim its directional antenna at the earth, as well as many other functions.

The spacecraft controller is an electronic solid-state timer. It takes 400 cycles per second from the spacecraft power source and divides it into one pulse per second, and uses these pulses as the basic timing reference. These pulses are accumulated in a storage device. The controller also contains a memory device which has a pre-set series of triggers.

When the accumulated pulses per second match the pre-set count stored in the memory device, a relay is closed and the controller issues a command for Ranger 2 to perform some specific function. From launch to the end of its useful life there are ten such commands that the controller must issue; hence there are ten such channels and ten such relays.

The controller timer is started three minutes before launch. This time then serves as the reference point for future commands to be issued by the controller. When the spacecraft is turned on, from power supplied by the large silver zinc battery inside the hexagon, most of the scientific instruments, and both the quarter-watt and the three-watt transmitter, begin to operate.

However, some instruments are not turned on, notably the solar corpuscular detectors, micrometeorite detector, and the Lyman Alpha telescope; the three-watt transmitter is given only enough power to run at half strength, or 1.5 watts. This is done because, as the launch vehicle passes through a critical

area between 150,000 and 250,000 feet, there is a tendency for devices using high voltage to arc over and damage themselves; hence these are turned on by the controller after this critical time is passed.

During the launch phase of the Atlas-Agena B launch vehicle, the Ranger 2 spacecraft is protected against aerodynamic heating by a shroud which covers it. After Atlas cut-off, at approximately 280 seconds, the shroud is jettisoned. At almost the same time that the protective shroud is pushed forward by eight spring-loaded bolts, the Agena B separates from the Atlas. At this time, the Agena B pitches down from an attitude almost 9 degrees above the local horizon to almost level with the local horizon.

In this horizontal mode, the Agena B fires for the first time and burns for almost $2\frac{1}{2}$ minutes to reach earth orbit speed of approximately 18,000 miles an hour. After $2\frac{1}{2}$ minutes of burning time, Agena B shuts down and coasts in a parking orbit for more than 13 minutes until it reaches the optimum point in time and space in its orbit to fire for the second time.

In the first two Ranger shots, which are not aimed at the moon, the mechanics of this parking orbit are not important, but will serve as a test of the procedure for use in later launches aimed at the moon. The parking orbit technique is a means by which the geometry imposed on moon shots by the location of the Atlantic Missile Range is corrected by using a second stage rocket as a mobile launching platform in space.

Injection of the Agena B and the Ranger spacecraft, still as one unit, occurs approximately over Ascension Island in the South Atlantic Ocean approximately 23 minutes after launch. Up to this time, the events of the launch, separation of Agena from the Atlas, operation of the Ranger spacecraft system and ignition, and cut-off times of Agena B have been telemetered to ground tracking stations through the Agena B telemetry system.

A little more than 2 minutes after injection, Ranger is separated from the Agena B, again by spring-loaded bolts. After this occurs, Agena B does a 180 degree yaw, fires up some solid retro-rockets and moves into a different and lower trajectory from that attained by Ranger. There are two reasons for this maneuver. It would not be desirable in later shots for the unsterilized Agena B to follow Ranger on in and impact the moon, and if Agena B closely follows Ranger, the spacecraft sensory system might mistake reflected sunlight from Agena B for the sun or the earth and thus confuse its acquisition system.

In any case, Ranger is now pointed on a trajectory which will take it out on a long swing away from the earth, and the dead Agena B rocket casing is slowed down on an orbit that will move it closer into the earth's atmosphere to ultimately burn up by friction.

Now it is possible to describe the sequence of the 10 commands issued to Ranger 2 by the spacecraft controller, and thus describe the operations of Ranger 2 on its long trip out and equally long swing back into earth. The commands and their timing are:

FIRST COMMAND--This is issued 2000 seconds (33 minutes, 20 seconds) after the controller was started, which was 3 minutes before the launch. This command is to the power source in Ranger 2, still being provided by the big silver zinc battery, to increase the power being sent to the larger transmitter from 1.5 watts to 3 watts. It is now possible to do this since the critical area, in which arcing over might have occurred, is passed, and the increased power allows the ground station near Johannesburg, South Africa, to more easily acquire the signal from Ranger 2. The Deep Space Instrumentation Facility station in South Africa also will be able to tell from telemetry from Ranger 2 that this command was issued to the spacecraft by the spacecraft controller.

SECOND COMMAND--This is issued at 2200 seconds (36 minutes, 40 seconds) and performs two separate functions. The first function is to extend, by means of a compressed spring, the electrostatic analyzer package in a small box on a small boom about 4 feet from the main body of the spacecraft. This is done so the two sensors in the electrostatic analyzer can look at the sun and away from the sun at the same time without interference from the body of the spacecraft. The second function of this command is to fire small squibs which pull out pins that hold the two solar panels locked in place. When these pins are displaced, compressed springs move the solar panels out, in the manner of butterfly wings, until they are at right angles to the length of the spacecraft. This operation requires perhaps half a minute.

THIRD COMMAND--This occurs at 3700 seconds (61 minutes, 40 seconds) and takes place while Ranger 2 is still sort of staggering through space as a result of the separation shock it received when it left Agena B. This command turns on the attitude control system and sends power to the sun sensors, the cold-gas jets, and the gyroscopes. The gyros first act to cancel out the residual movements resulting from separation.

There are ten sun sensors located on Ranger 2, spotted in areas so that no matter how the spacecraft is positioned in space, some of the sensors will see the sun. There are three sensors located on the backs of each of the two solar panels, making six there, and four located on the legs of the spacecraft. The sun sensors are light-sensitive diodes which inform the gas jets and the gyros when they see the sun. The attitude control system responds to these signals by turning the spacecraft in such a manner that the longitudinal or roll axis points toward the sun. Torquing of the spacecraft for these maneuvers is provided by ten cold-gas jets which are fed gas from a bottle, about 8 inches in diameter and containing $2\frac{1}{2}$ pounds of nitrogen under 3000 pounds pressure per square inch. This is calculated to be enough nitrogen to operate the gas jets to maintain attitude control for a minimum of 50 days and a maximum of 100 days.

The gyros have first acted to cancel out the residual separation rates which affected Ranger 2 after it left Agena B. The sun sensors then, working on the valves controlling the gas jets, jockey the spacecraft about until its long axis is pointed at the sun. Both the gyros and the sun sensors can activate the gas jet valves. In order to conserve gas, the attitude control system permits a pointing error toward the sun of one degree, or .5 degree on each side of dead on. The mixing network in the attitude control system is calibrated to keep Ranger 2 slowly swinging through this one degree of arc pointed at the sun. This swing takes approximately 60 minutes. As Ranger 2 nears the .5-degree limit on one side, the sensors signal the gas jets and they fire again. This process is repeated hourly through the effective life of Ranger 2. It is calculated that the gas jets will fire one-tenth of a second each 60 minutes to keep the spacecraft's solar panels aimed at the sun.

Approximately 15 to 30 minutes will be required initially to lock onto the sun. While this is taking place, the four-foot directional antenna which had been tucked up under the hexagonal bus is moved out to a pre-set angle. This is accomplished by the same command from the controller which initiated the sun acquisition.

When the sun is acquired within the allowable error, the power system now recognizes that it is getting electric power from the solar panels through the converter, so it switches off the large silver zinc battery and starts to use the electric power from the sun to feed the power demands of Ranger. The solar panels are expected to supply a minimum of 155 watts and a maximum of 210 watts. Ranger's power demand peaks at 15 watts.

After Ranger 2 has been locked onto the sun, the attitude control system turns off the six sun sensors located on the under sides of the solar panels. This is done to prevent the possibility of these sun sensors seeing the earth and perhaps confusing it with the sun.

FOURTH COMMAND--This is issued at 4900 seconds (81 minutes, 40 seconds) and turns on the scientific instruments which had not been turned on because of the passage through the critical altitude area.

FIFTH COMMAND--This occurs at 5600 seconds (93 minutes, 20 sec.) In effect, the spacecraft controller tells Ranger 2, "Okay, you've locked onto the sun, now start looking for the earth with your directional antenna but don't lose your lock on the sun." So, keeping its long axis rigidly pointed at the sun, Ranger starts looking for the earth with its earth sensor, which consists of three photo multiplier tubes mounted coaxially with the directional antenna. The spacecraft then starts to roll on its long axis, with the directional antenna extended at a pre-calculated angle. During the roll, the earth sensor will see the earth and inform

the gas jets. The jets will fire to keep the earth in view of the sensor, and thus lock onto the earth. The spacecraft now is stabilized on two axes, the solar panel-sun axis, and the earth-dirrectional antenna axis. There is some danger that the earth sensor, during its search for the earth, may see the moon and lock onto that, but telemetry will inform earth stations if that error occurs, and Goldstone has the ability to send an override command to the attitude control system to tell it to look again for the earth.

SIXTH COMMAND--This occurs at 7100 seconds (118 minutes, 20 seconds). This command changes the scale factor of a telemetry measurement which informed earth stations of the wobbling which Ranger went through when it was first separated from Agena B. The wobbling, now under control of the limit cycle of the attitude control system which keeps the spacecraft pointed at the sun, is considerably under the levels first encountered, so the scale factor of the telemetry of this information is adjusted to better accommodate the lower rates.

SEVENTH COMMAND--This occurs at 12,400 seconds (206 minutes, 40 seconds). It changes the scale factor in one of the six instruments carried in the State University of Iowa radiation experiment. In effect, it makes one of the six instruments more sensitive to provide a finer measurement of the radiation levels encountered.

EIGHTH COMMAND--This occurs at 15,000 seconds (250 minutes). It transfers data being sent from the three-watt transmitter from the omnidirectional antenna to the directional antenna, thereby greatly increasing the range from which the information can be sent. The quarter-watt transmitter continues to send the same data over the omnidirectional antenna. The delay between the time earth acquisition is made, at the end of the fifth command, and now to turn on the directional antenna is a safety precaution in the event that the spacecraft had failed to acquire the earth.

NINTH COMMAND--This occurs at 22,000 seconds (366 minutes, 40 seconds). It consists of a reduction in the rate at which the quarter-watt transmitter has been sending data over the omnidirectional antenna. The low power transmitter now is near its limits because of distance, so the amount of information it sends is reduced and its ability to communicate over longer distance is improved.

TENTH COMMAND--This occurs at 22,200 seconds (370 minutes). This command turns on an engineering experiment to try to determine some of the friction forces involved in the operation of machinery in the hard vacuum of space. Later in the lunar and planetary program, it will be desirable to land complicated mechanical instruments, with moving parts, on the moon and to have them operate in space. It is known now that most metals moving against other metals in hard vacuums have a tendency to stick fast together. This experiment, designed to determine the effect of space environment

on bearing materials, consists of a motor-driven shaft on which are mounted a series of discs of different material. Pressing against the discs are hemispheres of different material. Between the discs and the hemispheres, there are 80 different combinations of materials. Strain gages mounted on each hemisphere will telemeter to earth the drag force measured between each combination. This experiment is under the responsibility of Dr. Leonard D. Jafee and John B. Rittenhouse of the California Institute of Technology Jet Propulsion Laboratory.

Ranger 2 has a passive temperature control system to insure that its working parts, particularly the sensitive electronic components, neither freeze in the coldness of space nor melt in the face of direct sunlight unfiltered by earth atmosphere. This is done by using gold plating, white paint and polished aluminum on the spacecraft to balance the amount of heat taken in on the side of the space craft facing the sun and the amount of heat radiated from the spacecraft on the shadow side.

THE SCIENTIFIC EXPERIMENTS

There are eight scientific experiments on Ranger 2. They represent the work of scientists and engineers at seven institutions: the California Institute of Technology, Goddard Space Flight Center, Jet Propulsion Laboratory, Los Alamos Scientific Laboratory, Naval Research Laboratory, State University of Iowa, and the University of Chicago. Scientific aspects of the instrument system were the responsibility of Mrs. Marcia Neugebauer of JPL, project scientist; and Raymond L. Heacock of JPL, project engineer, was responsible for system engineering of the scientific instruments.

Most of the experiments examine the charged particles in the space outside the earth's atmosphere. These are protons, the nuclei of hydrogen atoms which continually fly out from the sun, and the very fast cosmic rays which stream across our solar system from unknown sources. Since such particles are electrically charged, their flight is strongly affected by the magnetic fields in space. At the same time, they create additional magnetic fields as they move through space. Thus the accurate measurement of the strength and direction of the interplanetary magnetic field is a second vital objective of the scientific program of Ranger 2.

Most of the particles which Ranger 2 will observe come originally from the sun. The magnetic field which Ranger 2 will measure originates primarily in the sun from which it is to some unknown extent transported and warped by the streams of particles. But neither the streams of particles nor the interplanetary magnetic field can be directly observed on the surface of the earth, or even from a point several hundred miles above the earth's surface. Not only does the atmosphere of the earth shield us from almost all of the relatively slow-moving particles that come from the sun, but also the magnetic field of the earth deflects the motion of the particles and overrides the comparatively weak magnetic field of space. In spite of this shielding, activities on the surface of the sun have very important consequences on the surface of the earth. For example, magnetic storms on the earth which interfere with radio transmission appear to be directly caused by disturbances on the sun, and even the aurora borealis--the northern lights--seem to result from solar activity. Of course, the earth's weather is controlled by the sun, and

changes in weather may result from variations in solar activity.

Many happenings on earth may be connected directly to happenings on the sun. However, our present understanding of solar behavior is limited in that we cannot really determine the mechanisms which relate some solar phenomena to the phenomena we observe here on the surface of the earth. The scientists making measurements on the Ranger 2 spacecraft hope that they can use these observations in making important strides in our knowledge of the sun and its relation to the earth.

Not only will the particles which stream outward from the sun be counted, and the magnetic fields which they carry with them that control their flight be observed, but also some of the x-rays produced by the sun will be detected.

One effect which we suspect the sun has on the earth is the production of a vast cloud of neutral hydrogen gas surrounding the earth like a super atmosphere. This cloud is very diffuse and its overall size and shape cannot be easily determined by making measurements actually within the cloud itself. Thus, when the spacecraft is many thousands of miles away from the earth, a special telescope will look back to scan the earth in a particular region of the far ultraviolet spectrum which contains that color of sunlight strongly scattered by neutral hydrogen gas. A crude picture of the earth and the space around it will reveal the presence of this gas and the extent to which it is compacted or diffused.

Still another experiment on the Ranger will detect tiny dust particles that fly through space. This measurement is also connected to the behavior of the sun, for the sunlight acts to push away very tiny particles in the same way that it pushes away the tail of a comet. Scientists today believe that the sun and all of the planets which move around it accumulated from a gigantic cloud of dust particles. The origin of these dust particles is still not known, nor is it known today whether the solar system is sweeping up more and more of these dust particles from space, whether dust particles are being left behind by comets passing close to the sun, or whether the particles that remain are simply the debris of the ancient solar system formation process. By measuring their size, their energy, and their direction of flight we hope to gain more knowledge about these tiny particles which can never be observed underneath the blanket of our atmosphere.

The Experiments:

SOLAR CORPUSCULAR RADIATION EXPERIMENT

This experiment is the responsibility of Mrs. Marcia Neugebauer and Dr. Conway W. Snyder, California Institute of Technology Jet Propulsion Laboratory. Its purpose is to determine the flow and movement of interplanetary plasma (clouds of charged particles) by observing the density and direction of motion of drifting plasma clouds and also by measuring the energies of the particles which make up these clouds.

Many scientists consider this interplanetary plasma as simply the continuation of the sun's atmosphere into the space between the planets. This atmosphere, or corona, consists mostly of protons and electrons. The cloud is so diffuse that ordinary pressure and temperature measurements can not be made. Some theories suggest that the interplanetary plasma is a relatively stationary cloud of gas surrounding the sun. On the other hand, other scientists believe that a solar wind constantly streams away from the sun. This solar wind consists of ionized atoms of gas (primarily hydrogen) which move with velocities of several hundred to a thousand miles a second.

All descriptions of the interplanetary plasma picture it as being disturbed by outbursts of solar activity--solar flares or magnetic storms on the surface of the sun. At such times, the density, the speed of flow, and the temperature of the interplanetary plasma probably all change.

Most particle detectors are enclosed in shields or tubes which would keep out the very low energy particles expected to exist in interplanetary plasma. The electrostatic analyzers carried on board the Ranger, however, are open to space, and can collect and measure the lowest energy particles. Six such detectors are carried pointing in six different directions. (If you were standing on the Ranger you would find one pointing above you, one below, one to the front, one behind, one to the right and one to the left.)

As a charged particle enters the analyzer, it finds itself in a curving tunnel. The two sides of this tunnel are metal plates carrying static electric charges, one negative, the other positive. The charged particle is attracted by one plate and repelled by the other, and so follows a curved path down the curved tunnel. If it is moving too slowly or too rapidly, it runs into one wall or the other. But if it is moving at just the right speed, it makes its way all the way

to the end and is there detected by a particle counter. Thus, all the particles moving in the right direction to enter the tunnel and moving with the right speed to get all the way through will be detected.

Automatically, at fixed intervals, the amount of the static charge on the metal side plates is changed, so that a different range of energy is required for the particles to get through. Twelve such voltage steps are included in a cycle through the analysis process. As a result, a spectrum of particle energies is obtained which shows the number and the direction of flow of protons and electrons in the solar plasma whose energies are characteristic of the suspected solar wind.

In order to determine whether the particles are streaming outward from the sun as a solar wind, or wandering at random through a comparatively stationary plasma cloud, the most fundamental measurement is a comparison of measurements taken looking toward the sun and looking directly away from the sun. The pair of analyzers which makes these two measurements is positioned on a boom located several feet out from the body of the spacecraft. This removes these analyzers from the effects of any sheath of charged particles, or "atmosphere," which the Ranger may accumulate about itself as it moves through the interplanetary plasma.

In cycling through its voltage sequence, each analyzer will observe four energy ranges of electrons between 13.7 and 110 electron volts and eight energy ranges of protons between 13.7 and 5500 electron volts.

The six units in this experiment have a total weight of 33 pounds and a power requirement of 2.74 watts. C. S. Josias and J. L. Lawrence of JPL performed the engineering design of this experiment.

MEDIUM-ENERGY-RANGE PARTICLE DETECTORS

Six medium-energy-range particle detectors will observe charged particles in an energy range which overlaps the low energies of the particles in the interplanetary plasma, and which extends upward toward the high energies of the fast moving cosmic rays.

Three of these units are cadmium sulfide detectors--solid state semi-conductor devices which change their electrical resistance in proportion to the rate at which they are being bombarded by charged particles. As in the case of the solar corpuscular radiation detectors, these instruments are not

covered by any protective tube wall or case. Thus, particles of very low energy can be detected. Protons and electrons with energies greater than 100 electron volts will, upon striking the cadmium sulfide detectors, produce a measurable change in resistance. Sunlight also produces such a change, so the detectors are placed behind a series of light baffles designed to protect them against the accidental illumination by reflected sunlight.

One of these detectors includes a small magnet. An electron with energy below 400,000 electron volts moving toward the detector would be swept aside by this magnet and thus not be counted, whereas the much heavier protons will proceed nearly straight on. The other two detectors contain no such magnets and will consequently count both electrons and protons. One of these detectors has an automatic aperture adjustment which cuts out most of the particles while the Ranger is passing through the earth's radiation belts. This permits the detection of the very large number of particles found in the radiation belts with the same detector used to count the very small number of particles in interplanetary space. The three counters are arranged to point in two different directions -- at about 45 degrees to the direction of the sun.

This experiment was developed by the Department of Physics and Astronomy, State University of Iowa, under the direction of Professor James A. Van Allen. Professor Van Allen's group also developed another experiment employing two Geiger-Mueller counters similar to those with which Professor Van Allen discovered the existence of the vast belts of radiation around the earth--the Van Allen Belts. These Geiger-Mueller tubes which point at right angles to each other, will count protons which have energies above 3,000,000 electron volts, and electrons with energies above 200,000 electron volts. It will make accurate reporting of the count up to a rate as high as 20,000 particles per second.

Drs. C. Y. Fan, P. Meyer, and J. A. Simpson of the Cosmic-Ray Group at the University of Chicago are supplying an experiment which also uses a solid-state detector for observing charged particles. The detector consists of two thin discs of silicon coated with gold and then placed one behind the other. A proton with an energy greater than one-half million electron volts will enter the first disc and produce a shower of ions strong enough for the electronic circuits to register a count. If the proton has an energy less than five million electron volts, it will not be able to get all the way through the first disc. The electronic circuits can determine whether pulses come from both discs or just the front one, and thus

determine whether the particle entering the first disc had an energy less than or greater than five million volts. Particles with energies greater than five million electron volts will penetrate into the second disc and cause another shower of ions and a pulse from the second disc. If the energy is greater even than ten million electron volts, it will proceed so rapidly through the first discs that the resulting shower of ions will be too weak to record as a count. Thus ten million electron volts is the upper energy limit of the counter. Coincidental counts on both discs will indicate that the entering particle had an energy between five and ten million electron volts.

This detector has the advantage of being sensitive only to particles coming from one hemisphere in space. It has the further advantage of being completely insensitive to electrons and x-rays, so it will count only the nuclei of atoms--principally protons, the nuclei of hydrogen atoms.

The total of six medium-energy-range particle detectors weigh 3.8 pounds and consumes approximately 0.16 watts of power. J. Denton Allen and Dr. Conway Snyder provided JPL's engineering and scientific support for this experiment.

COSMIC-RAY IONIZATION RATE MEASUREMENT

Primary cosmic radiation and other ionizing radiation in the space beyond the earth's atmosphere will be measured by a quartz-fiber integrating type ionization chamber, invented by Dr. H. V. Neher of the California Institute of Technology.

The quartz-fiber ionization chamber works in a manner similar to the gold leaf electrometers which are found in high school physics laboratories.

In the Ranger ionization chamber, a quartz fiber is positioned a short distance from a quartz rod inside a hollow metal shell (the chamber). Initially, both rod and fiber are charged to the same voltage. As cosmic rays penetrate the wall of the ionization chamber and shoot across the gas inside, they leave behind a wake of charged ions--the molecules of the filling gas split into positive and negative parts. Negative ions and electrons drift toward the quartz rod and build upon it a static charge, which attracts the fiber. When enough ions have been produced and have drifted to the rod and enough charge is built up, the fiber is pulled close enough to touch the rod. This produces an electric pulse which is amplified and sent out over the Ranger data telemetry system, and at the same time discharges the rod, returning the instrument to its starting position. The time interval between successive pulses of this type indicate the rate at which cosmic rays

are penetrating the wall of the ion chamber. Protons which penetrate must have an energy of at least ten million electron volts.

Storms on the surface of the sun are known to produce many highly energetic particles which will be hazardous to men in space. The importance of the ionization chamber lies in its ability to measure this potentially dangerous radiation, and also in its characteristic as an absolute standard for all radiation measurements. Chambers of the same design have been flown on balloons for several years in the study of cosmic rays. Measurements made with these chambers can be compared with each other from year to year, with complete reliance on the uniform and consistent characteristics of the measuring instrument. Thus, measurements made with such a chamber can be used to connect the measurements of many of the particle counters on the Ranger with many of the cosmic ray measurements which have been made here on earth over the last several decades. Furthermore, continued use of such ionization chambers on future spacecraft will permit the future radiation measurements to be compared against an absolute basic measurement.

The complete experiment, in which Drs. H. R. Anderson and W. S. McDonald of JPL participated with Professor Neher, weighs 1.3 pounds and requires about 0.01 watts for operation.

TRIPLE - COINCIDENCE COSMIC-RAY ANALYSIS

High energy radiation in interplanetary space will be measured by an experiment developed by three scientists of the University of Chicago, Drs. C. Y. Fan, P. Meyer and J. A. Simpson. Each of the two triple-coincidence telescopes carried on the Ranger consists of an assembly of seven proportional-counter tubes arranged in the same manner as in units successfully flown on the Explorer VI satellite and Pioneer V space probe. They are cylindrical bundles, with six tubes on the perimeter and the seventh in the center.

These two cylindrical bundles lie on their side projecting through the top of one of the equipment boxes in the hexagonal base of Ranger 2. In each bundle, the counting tubes are connected in three separate groups: the first group consists of the outer three tubes which are exposed to the space outside the equipment box. The second "group" is the single tube in the center of bundle, and the third group consists of the three tubes which lie on the bottom of the bundle and actually project into the equipment box in which the instrument is mounted. As a charged particle comes through the bundle of tubes, the electronic circuits determine which

of the groups the particle has penetrated. When a pulse is received from all three groups at the same time--a triple-coincidence--this indicates that the particle responsible was undoubtedly a high energy particle rather than an x-ray or a low energy particle. Operating in the triple coincidence mode, the instrument discriminates strongly against x-rays.

Such "triple-coincidence events" are telemetered back to earth by the Ranger 2 data telemetry system, together with single counts from the center tube. A single count from the center tube will, five times out of a hundred, be caused by an x-ray rather than a high energy charged particle (assuming both have the same chance of entering the center tube.) By comparison of the single count data and the triple coincidence data, the scientists responsible for the experiment can then determine how many of the counts were due to x-rays and how many were due to protons or other high energy charged particles.

The two bundles of counters differ from each other in the amount of shielding placed around them. One bundle is covered with a shell of lead which keeps out all protons with energies less than 75 million electron volts and all electrons with energies less than 13 million electron volts. The other bundle has a lead shield only around its lower half, the half that projects into the equipment box. Protons of greater than 10 million electron volts and electrons with energies greater than $\frac{1}{2}$ million electron volts are permitted to enter the bundle from the unshielded upper half.

The location of the bundles is such that particles coming directly from the sun can penetrate and be counted without having to go through any portion of the spacecraft before reaching the counters.

The energy range of particles detected by the half-shielded bundle is similar to the energy range of particles which will be detected by the quartz-fiber ionization chamber. A comparison of the readings of these two instruments--the average ionization rate from the quartz-fiber chamber, and the individual particle impact rate from the triple-coincidence counter--will allow the scientists to determine the average ionization per particle. This in turn will permit them to determine the type and energy of particles responsible for the measurement--protons, alpha particles, or perhaps heavier nuclei or x-rays. It is anticipated that almost all of the particles will be protons, the nuclei of hydrogen atoms.

The total weight of this experiment, counters, lead shielding, and the electronic circuits associated with the

counters, is 9 pounds, and the experiment consumes $\frac{1}{2}$ watt of electrical power. J. Denton Allen and Marcia Neugebauer provided Jet Propulsion Laboratory's engineering and scientific support for this experiment.

MAGNETIC FIELD ANALYSIS

Ranger carries a rubidium vapor magnetometer to measure the strength and direction of the magnetic field in interplanetary space. The nature of the interplanetary field is closely connected to the behavior of charged particles which make up the solar plasma.

Present-day theories of magnetohydrodynamics--the study of the relation between the motion of charged particles and the magnetic field which surrounds them--say that the plasma which flows away from the sun should drag with it the local solar magnetic field, since the motion of charged particles not only responds to but also creates magnetic fields. The mathematical description of this interaction between the stream of charged particles leaving the sun and the magnetic field which surrounds the sun is extremely complicated. The theories which have been used to describe these phenomena are incomplete and often contradictory. In order to make any headway at all against the mathematical difficulties, scientists are forced to assume various characteristics of the interplanetary plasma. However, at present, there is no way of determining whether these assumptions are realistic.

The results of the Ranger 2 measurements on the magnetic fields in interplanetary space will be used to check the conclusions of the various theories now existing, and will also be used to provide a new set of still more valid assumptions for the creation of more conclusive theories.

Several earth satellite measurements, and measurements taken by the interplanetary probes, Pioneer I, Pioneer V and Explorer X have given us a few pieces of information about the field at great distances from the earth, and information about the nature of the magnetic field in the space between the earth and the moon. It is in this latter region of space that the interplanetary field and the earth's magnetic field interact to form a complicated boundary. Some scientists believe that the detailed structure of this boundary may explain the creation of the Van Allen radiation belts. Some aspects of the magnetic field in this region indicate the existence of a vast current ring encircling the earth outside of the major radiation belts. The particles in this ring may have been detected by Soviet space probes. Russian scientists have

reported such observations.

Here on earth we can observe changes in the bombardment rate of cosmic rays--the charged particles which have enough energy to penetrate all the way through our atmosphere and our magnetic field. In many cases, these changes cannot be ascribed to any changes in the earth's own magnetic field, but may well result from changes in the interplanetary field.

Thus it can be seen that the data from the magnetometer measurement will be of fundamental importance in interpreting the results of the various charged particles experiments which are carried on board Ranger 2. The combination of charged particle measurements and magnetic field measurement will be of tremendous value in advancing our knowledge in the behavior of the sun and its effects upon phenomena here on the surface of the earth.

The rubidium vapor magnetometer relies upon fundamental atomic laws which govern the behavior of the atoms of rubidium gas when they are in the presence of a magnetic field. The small cell of rubidium vapor gas, whose behavior will indicate the strength of the magnetic field, is located at the center of a hollow 13-inch diameter fiber glass spherical shell. Wrapped around this shell are coils of wire through which electric currents of known strengths can be sent during the measuring sequence. By the proper sequencing of currents in the coils both the strength and the direction of the magnetic field in space can be determined. This unit is located near the front end of Ranger 2 as far as possible from the electronic circuitry in and near the hexagonal base. This minimizes the effect of the magnetic background from the spacecraft and its electronic components.

The experiment weighs 5.75 pounds, was developed under the direction of Dr. J. P. Heppner and J. D. Stolarik of the National Aeronautics and Space Administration's Goddard Space Flight Center. The experimental equipment consumes a power of 4.1 watts. Scientific and engineering support for this experiment is provided by D. E. Jones and M. Gumpel of the Jet Propulsion Laboratory.

SOLAR X-RAY DETECTION

A pair of scintillation counters are mounted on Ranger as part of the Atomic Energy Commission's contribution to the Air Force's Vela Hotel project. This experiment is supplied by Dr. John A. Northrop of Los Alamos Scientific Laboratory in conjunction with a group at the Sandia Corporation.

These scintillation detectors are located about a foot apart with their sensitive surfaces facing the sun. They are designed to detect bursts of low-energy x-rays originating at the sun. Six opaque windows in front of each scintillation detector are intended to provide the best possible protection against cosmic dust puncture while permitting the passage of x-rays to the detecting portions of the instruments.

It is well known that the sun is not only a copious source of such radiation, but also that it is far from being a source of constant intensity. This equipment, therefore, is designed to detect extremely short-term variations so that future instruments sent into space can judge when a man-made nuclear explosion has taken place, or whether the detected event is simply a solar outburst.

The equipment weighs approximately 12 pounds and includes its own power supply, logic, and data handling system. Timers keep the high voltage removed from the photomultipliers in the scintillation counters for 8 hours during passage through the radiation belts of the earth.

NEUTRAL HYDROGEN GEOCORONA

The design of this experiment is under direction of T. A. Chubb and R. W. Kreplin of the Naval Research Laboratory and H. T. Bull and D. D. LaPorte of the Jet Propulsion Laboratory. It employs a telescope and detector sensitive to the Lyman-alpha region of the spectrum (the color of the neutral atomic hydrogen gas) which will scan the region containing the earth after Ranger 2 has proceeded far into space.

Scientists at the Naval Research Laboratory have previously observed the glow of neutral hydrogen gas outside the earth's atmosphere from instruments carried in high altitude sounding rockets. They concluded that this glow resulted from a cloud surrounding the earth, but the extent and shape of this cloud could not be determined from these measurements taken from deep within it. It is possible that this cloud will have some sort of a long tail much like the tail of a comet. The cloud may be diffuse or relatively compact depending on its temperature.

As the telescope is mechanically scanned across the sky, a detector sensitive to this Lyman-alpha radiation will produce an electrical signal proportional to the amount of Lyman-alpha light which strikes it. The result will be very similar to a crude television picture taken of the earth and its surroundings in this particular color of light. As Ranger 2 proceeds out from the earth, it will take a series

such pictures, and in each one the earth will occupy a smaller and smaller area.

No one is certain of the exact details of what the Lyman-alpha telescope will see. There are, however, theories which could account for a hydrogen cloud extending far into nearby space. Hydrogen is formed by the action of sunlight upon water vapor and marsh gas high in the earth's atmosphere at an altitude of approximately 60 miles. The released hydrogen gas then diffuses outward to form the main constituent of the earth's very high upper atmosphere. In this high altitude region, the neutral hydrogen could reflect the Lyman-alpha radiation put out by the sun or could possibly emit radiation of its own after being bombarded by high energy radiation from the sun or the earth's radiation belts. It thus appears as if we have a glowing corona round the earth quite analogous to the corona of the sun.

If the solar wind sweeps out from the sun, as would be indicated by the shape of the comet tails, then the gas at the outer edge of the cloud is probably being continually swept away from the earth, giving the earth a tail like a comet. If, on the other hand, no such solar wind exists, the neutral hydrogen may simply merge with the more diffuse gas of interplanetary space.

Since the density and behavior of this hydrogen cloud depends on the behavior of the solar plasma and the strength of solar winds, it is clear that proper interpretation of the data from the Lyman-alpha telescope will require the data from the solar corpuscular radiation measurement as well as the medium energy particle measurements and the magnetometer measurements. The Lyman-alpha telescope may give observations of other phenomena such as the aurora borealis (northern lights) occurring during the lifetime of the experiment, or stars which shine with particular brilliance in this special region of the spectrum and are located in a position where the telescope will see them in sweeping back and forth across the vicinity of the earth.

The gimbal-mounted telescope together with its Lyman-alpha detector and the associated electronics weighs 15 pounds and consumes 1.4 watts of electrical power.

COSMIC DUST DETECTORS

Impact rate, energy, momentum, and direction of flight of dust particles in interplanetary space will be measured by a miniature cosmic dust detector designed by a group at NASA's Goddard Space Flight Center, Greenbelt, Maryland, under the direction of W. M. Alexander.

Housed in a magnesium container measuring 3" x 6" x 5½", the instrument consists of a light-flash detector sensitive to minute bursts of light produced by dust particle impacts, and a special microphone attached to the sensitive exposed surface. The experiment is located on Ranger 2 so that it will detect particles moving around the sun in the same direction as the earth and those moving in the opposite (retrograde) direction during different portions of the flight.

Analysis of the data which result from this experiment should show both the mass and speed of particles which are detected as well as their direction of flight. This will give information as to whether the measured particles are in orbit around the earth or moving free of the earth in orbit around the sun. Previous measurements from earth satellites and sounding rockets have indicated a strong concentration of dust particles near the earth, which some scientists believe indicates the presence of a cloud of trapped dust particles in orbit around the earth. Other scientists feel that the concentration is due simply to the earth's gravitational effect upon a swarm of dust particles in motion around the sun.

Information on the orbits of these particles and on their sizes will give scientists a better understanding of the distribution of matter in the solar system. Scientists believe that the sun and the planets were formed by the condensation of a vast cloud of dust particles some five billion years ago. It is possible that the dust particles now existing in the solar system are the remnants of this original condensation, or it is possible that they come from the breakup of comets which fall in toward the sun from a point far outside the farthest planet. Some have suggested that dust particles from interstellar space are constantly sweeping into the region of the solar system and being trapped by the interaction of the gravitational fields of the sun and planets, thus contributing a steady influx of matter to the whole solar system.

It is not likely that these beginning measurements of dust and interplanetary space carried out onboard Ranger 2 will enable scientists to decide among the various possibilities. However, the measurements should give scientists a much better basis for further calculations on the origin and history of the solar system and material within it.

The cosmic dust detectors and their associated electronics weigh 3.55 pounds and consume 0.20 watts of electrical power. Scientific and engineering support for this experiment is provided by Marcia Neugebauer and E. S. McMillan of Jet Propulsion Laboratory.

SCIENTIFIC EXPERIMENTS

<u>Experiments</u>	<u>Description</u>	<u>Experimenter</u>
Solar Corpuscular Radiation Analysis	Electrostatic analyzers for study of low energy, charged particles, most of which originate in the sun.	JPL: M.M. Neugebauer, Dr. C.W. Snyder
Medium-energy range Particle Detection	Three sets of particle detectors: 1. Cadmium sulfide cells; 2. Geiger-Mueller counter; 3. Gold-silicon solid state detector.	State University of Iowa: Dr. James A. Van Allen University of Chicago: Drs. C.Y. Fan, P. Meyer, J.A. Simpson
Cosmic Ray Ionization rate measurement	Quartz-fiber integrating type ionization chamber to measure bombardment rate of energetic charged particles.	Caltech: Dr. H.V. Neher; JPL: Drs. H. R. Anderson, W.S. McDonald
Triple-Coincidence Cosmic Ray Analysis	Proportional-counter tubes to measure kinetic energy of fast charged particles in space.	University of Chicago: Dr. C.Y. Fan, P. Meyer, J. A. Simpson
Magnetic Field Analysis	Rubidium vapor type magnetometer to measure direction and strength.	NASA Goddard Space Flight Center: Dr. J.P. Heppner
Solar X-Ray Detection	Scintillation counters to detect low energy sun bursts of x-rays.	Los Alamos Sci. Lab: Dr. J.A. Northrop
Observation of Neutral Hydrogen Geocorona	Parabolic mirror with ionization chamber, to depict nature and distribution of hydrogen cloud around the earth.	Naval Research Lab: T.A. Chubb, R.W. Kreplin; JPL: D.D. LaPorte, H.T. Bull
Cosmic Dust Detection	Scintillator-type photomultiplier and microphone to measure particle impact rate, energy, momentum and direction of dust particles.	NASA Goddard Space Flight Center: W.M. Alexander

LAUNCH VEHICLE FACT SHEET

The National Aeronautics and Space Administration's Ranger 2 spacecraft will be launched by an Atlas Agena B rocket. This will be NASA's second use of the Atlas Agena B, a combination of two proven rockets which have figured prominently in earlier space exploration.

On August 23, 1961, Ranger I was launched by Atlas Agena B. Due to a malfunction, the spacecraft was ejected in a low earth orbit (apogee 312.5 miles; perigee 105.3 miles) rather than the highly eccentric orbit for which it was programmed. The launch resulted in a satisfactory test of many spacecraft components. Ranger I reentered the atmosphere on August 29 after 111 orbits of the earth.

The rocket is procured from industry by the NASA Marshall Space Flight Center through the Air Force Space Systems Division.

This unique relationship is spelled out in a NASA/USAF agreement which provides that the Air Force will furnish NASA a number of vehicles consisting of modified Atlas and Thor boosters with modified Agena B's serving as second stages. The Agena was developed for the Air Force Discoverer satellite program, in which it has achieved a significant reliability record. (The agreement between NASA and the Air Force says that "In order to take advantage of the existing USAF capability and procedures, the NASA is implementing the Agena program through established USAF . . . channels.)

Major contractors involved in the vehicle operation are Lockheed Missile and Space Division and General Dynamics-Astronautics. The launching at Cape Canaveral will be conducted by these companies and the Air Force under the direction of the Marshall Center's Launch Operations Directorate.

Launch Vehicle Flight Plan

The Atlas/Agena vehicle carrying Ranger 2 will lift off Pad 12 at Cape Canaveral executing a programmed roll and pitch maneuver to achieve a launch azimuth of 108 degrees.

All engines of the Atlas -- booster, sustainer and vernier -- are burning at liftoff. The booster is programmed to burn approximately 2-1/2 minutes; the sustainer about 4-1/2 minutes and the verniers about 5 minutes. At Atlas burnout the vehicle should be about 80 miles high and some 350 miles down the Atlantic Missile Range.

Prior to sustainer cutoff the Atlas ground guidance computer determines the velocity when vernier cutoff occurs and coast begins. Acting on this data the computer establishes the time when a signal to the Atlas airborne guidance system starts a timer aboard the Agena. This timer and an auxiliary timer in the Agena control the sequence of events which occur after separation from the Atlas.

When vernier cutoff occurs, the entire vehicle goes into a coast phase of about 25 seconds. First the shroud protecting the Ranger spacecraft during its exit through the earth's atmosphere is separated by a series of springs. Next small explosive charges release the Agena carrying the spacecraft from the Atlas. Retro-rockets on the booster fire, slowing its upward flight and allowing the Agena to separate. Then the Agena pneumatic control system begins a pitch maneuver to orient the vehicle into an attitude horizontal to the earth. This pitch maneuver is programmed to be completed before the timer signals ignition of the Agena engine.

At engine start the hydraulic control system takes over keeping the vehicle horizontal during the approximately 2-1/2 minutes the engine is operating. The infra-red horizon sensing device sends minute corrections to the control system.

If all events have gone as programmed, at Agena engine cutoff the vehicle and its Ranger payload will be in a near circular orbit around the earth at an altitude of about 100 miles. This first orbit is called a "parking orbit."

The Agena now coasts in its parking orbit for approximately 14 minutes. The pneumatic control system takes over maintaining the vehicle in the proper attitude with respect to the earth. At the proper instant the timer again signals the Agena engine to begin operation. This second burn is programmed for approximately 1-1/2 minutes.

Approximately 2-1/2 minutes after final engine shutdown the Ranger spacecraft is separated from the Agena by springs. This occurs about 25 minutes after liftoff. The pneumatic control system in the Agena now begins a maneuver turning the vehicle 180 degrees on its yaw axis so that it is traveling tail first. About 6-1/2 minutes after Ranger separation a retro-rocket on the Agena fires providing retro

thrust to slow the Agena. (In later Ranger launches when the trajectory is in the direction of the moon this maneuver will prevent the Agena stage from impacting on the moon.)

At separation from the Agena the Ranger spacecraft should be traveling about 23,800 miles per hour.

The operation of the Agena second burn will be monitored by an Army missile tracking ship, the American Mariner, which service will be provided to the Marshall Center by the Army Ordnance Missile Command. The ship will be located near Ascension Island, where the Agena's second burn period will occur. In this initial Ranger launching, the tracking could be accomplished at the Atlantic Missile Range station at Ascension. This, however, will provide a "drill" for the ship in preparation for later launchings in which the rocket's path will be out of range of the AMR station.

Atlas "D" Space Boosters

PROPULSION: Cluster of three rocket engines--two boosters, one sustainer, using liquid propellants.

SPEED: Approximately 12,000 statute miles per hour for the mission.

THRUST: Total nominal thrust at sea level more than 360,000 lbs.

SIZE: Approximately 78 feet high including adapter for Agena; 16 feet wide across flared engine nacelles. 10 feet wide across tank section.

WEIGHT: Approximately 260,000 lbs. at moment of launch, fully loaded with propellants - liquid oxygen and RP-1 and adapter sections -- approximately 15,800 lbs.

GUIDANCE: Radio Command guidance. Airborne elements sense velocity and vector transmitting this data to ground computer. Computer determines corrections necessary and transmits information to airborne unit which signals control system. Control accomplished through engine gimbaling and engine burning time.

CONTRACTORS: Airframe and assembly - Convair Astronautics; Propulsion - Rocketdyne Division of North American Aviation; Radio command guidance - Defense Systems Division of General Electric Company; Ground guidance computer - Burroughs Corporation.

Agena "B" Second Stage

PROPULSION: Single rocket engine using liquid propellants - inhibited red fuming nitric acid (IRFNA) and unsymmetrical dimethyldrazine (UDMH).

THRUST: 15,000 pounds at altitude.

SIZE: Approximately 22 feet long including adapter to accept Ranger I. 8 feet of Agena fit into adapter atop the Atlas booster.

WEIGHT: Approximately 15,000 pounds including adapter to accept Ranger 2.

PAYLOAD: Ranger 2 and shroud weighing approximately 790 pounds.

CONTROL SYSTEMS: Pneumatic, using high pressure gas metered through external jets for use during coast phases. Hydraulic through gimbaling rocket engine during powered portions of flight. Both are fed by a programmer initiated by airborne timers. Corrections are provided by the airborne guidance system.

GUIDANCE: Agena guidance is not dependent on ground-space radio links. The guidance system which is made up of timing devices, an inertial reference platform, a velocity meter and an infra-red horizon sensing device, is entirely self-contained. Final data on the velocity of the launch vehicle is computed by the Atlas ground guidance computer prior to separation of the Agena. Signals to start the timers in the Agena are sent to the Atlas via radio and are transmitted by "hard wire" to the Agena before staging occurs. Commands to ignite the Agena rocket engine are initiated by the respective timer for first and second burn. The velocity meter (an accelerometer device) initiates engine shutdown signals as necessary to achieve the desired terminal velocity. The infra-red horizon sensor "looks" for the horizon and sends corrections to the control system. The inertial reference platform keeps the vehicle stable in all three axes sending the necessary pitch, yaw and roll corrections to the control system.

CONTRACTORS: Lockheed Missile and Space Co., prime contractor; Bell Aerospace Co., engine.

Key Management Personnel

Agena B direction at NASA Headquarters is provided by the Office of Launch Vehicle Programs. The Agena program manager is Dick Forsythe.

The field installation charged with managing the vehicle program is the NASA Marshall Space Flight Center. Hans Hueter heads the Center's Light and Medium Vehicles Office. Friedrich Duerr is the Agena systems manager.

Major John G. Albert is the director of the NASA Agena B program for the AF Space Systems Division, assisted by Major Charles A. Wurster.

Harold T. Luskins is the Lockheed Missile and Space Co. manager of NASA programs.

Charles Cope of the NASA LOD performs liaison between Huntsville and Canaveral, with respect to launch activities.

DEEP SPACE INSTRUMENTATION FACILITY

The Deep Space Instrumentation Facility (DSIF) consists of three space communication stations located approximately 120 degrees apart around the earth, and a mobile station which can be located to suit the purpose of a particular mission. The three permanent stations are Goldstone, California; Woomera, Australia; and near Johannesburg, South Africa.

The DSIF is under the technical direction of the California Institute of Technology Jet Propulsion Laboratory for the National Aeronautics and Space Administration. Dr. Eberhardt Rechtin is JPL's DSIF Program Director.

In the lunar and planetary programs, the mission of the DSIF is to track, receive telemetry from and send commands to spacecraft from the time they are injected into orbits until they finish their missions.

Since they are located approximately 120 degrees apart around the earth, the three stations can provide 360 degree coverage around the earth so that one of the three always will be able to communicate with a distant spacecraft.

In the case of Ranger, the mobile station, under a crew headed by Earl Martin of JPL, will locate its 10-foot-in-diameter tracking station at a position approximately one mile east of the DSIF station near Johannesburg.

The mobile station will be used in that location because it has the advantage of having a 10-degree beam width--ten times as wide as the 85-foot-in-diameter dish--and it can track at a rate of 10 degrees per second, also ten times as fast as the big dishes. On the other hand, since its antenna is not so large as the big dishes, it cannot match the big dishes in range and consequently will be used only in the initial part of the flight.

Based on nominal performance and a nominal trajectory, the initial Ranger acquisition and loss times for each DSIF station are:

Mobile Station, South Africa--Acquires 5 minutes after
injection, holds for 13 hours.

DSIF, Johannesburg--Acquires 10 minutes after injection,
holds for 13 hours.

DSIF, Woomera--Acquires 25 minutes after injection, holds
for 6.5 hours.

DSIF, Goldstone--Acquires 12 hours after injection, holds for 11 hours.

The Goldstone DSIF station, located 50 miles north of Barstow in the Mohave Desert, is regarded as the research and development center of the DSIF, in that pioneering techniques and hardware are tested and proved out at Goldstone for the benefit of the other two stations.

Goldstone is equipped with two 85-foot-in-diameter antennas, one for receiving and one for transmitting. The two antennas are seven air miles apart, separated by a ridge of hills to minimize the possibility of interference between the two.

Goldstone is operated for JPL by the Bendix Radio Corporation. JPL's engineer in charge is Walter Larkin.

The Australian DSIF is 15 miles from Woomera Village in South Australia. It consists of an 85-foot-in-diameter receiving antenna and supporting equipment and buildings. The Woomera station is operated by the Australian Department of Supply, Weapons Research Establishment; Dr. Frank Wood represents the WRE. JPL's resident engineer is Richard Fahnestock.

The South African station, like the Island Lagoon station, consists of an 85-foot-in-diameter receiving antenna and supporting equipment and buildings and is located in a bowl-shaped valley approximately 40 miles northwest of Johannesburg. The South African station is operated by the South African government through the National Institute for Telecommunications Research; Dr. Frank Hewitt, director. NITR is a division of the Council for Scientific and Industrial Research. JPL's resident engineer is Paul Jones.

The two overseas stations and Goldstone are equipped with a communications network which allows tracking and telemetry information to be sent to the JPL Communication Center in Pasadena for processing by JPL's IBM 7090 computer.

RANGER CONTRACTORS

--Eighteen subcontractors to the California Institute of Technology Jet Propulsion Laboratory provided instruments and hardware used on the Ranger spacecraft. They are:

American Missile, 15233 Grevillea Avenue, Lawndale, Calif., telemetry encoders, power switching and logic assembly; Applied Physics, 2724 S. Peck Road, Monrovia, Calif., dynamic capacitor; Consolidated Systems, 1500 S. Shamrock Avenue, Monrovia, Calif., Lyman Alpha telescope; Hoffman Electronics Corporation, 1001 No. Arden Drive, El Monte, Calif., solar cells; Horkey-Moore, 24660 S. Crenshaw Boulevard, Torrance, Calif., spacecraft system test stand; International Telegraph and Telephone, 15191 Bledsoe Street, San Fernando, Calif., static power converter modules; Leach, 18435 Susana Road, Compton, Calif., telemetry checkout; Lockheed Aircraft Corporation, Missile and Space Division, 7701 Woodley Avenue, Van Nuys, Calif., prototype sterilization cart; Motorola, Inc., 8201 East MacDowell Road, Scottsdale, Ariz., transponders and radio command program.

Nortronics, Division of Northrop Corporation, 222 N. Prairie Avenue, Hawthorne, Calif., sun and earth sensors; Radiaphone, 600 East Evergreen Avenue, Monrovia, Calif., scientific instruments, ground support equipment; Servomechanisms Inc., 12500 Aviation Boulevard, Hawthorne, Calif., electro gating system; Space Technology Laboratories, 5730 Arbor Vitae, Los Angeles, Calif., scientific instruments, engineering services; Spectrolab, Inc., 11921 Sherman Way, North Hollywood, Calif., Lyman Alpha mirror; State University of Iowa, radiation detector.

Texas Instrument, Apparatus Division, 6000 Lemmon Avenue, Dallas, Tex., ground support equipment, flight data encoders; United Electrodynamics, 200 Allendale Road, Pasadena, Calif., pole beacon encoders, flight friction and ground test sets.

In addition to these subcontractors, there were 1500 industrial firms who contributed to the Ranger Program. The cost of these supplies amounted to \$12 million.

RELEASE NO. 61-224-6

FOR RELEASE: AM's Tuesday
October 17, 1961

SECRET

LAUNCH VEHICLE ----- Atlas Agena B

DIMENSIONS LAUNCH VEHICLE --

Total height, with Ranger spacecraft, ---- 100 plus feet
plus shroud

Atlas ----- 66 feet

Agena B ----- 22 feet

Ranger with shroud ----- 12 feet

DIMENSIONS RANGER

In launch position, folded

Diameter ----- 5 feet

Height ----- 11 feet

In cruise position, panels unfolded

Span ----- 17 feet

Height ----- 13 feet

WEIGHT RANGER

Structure ----- 125 pounds

Solar Panels ----- 50 pounds

Electronics ----- 261 pounds

Launch-Backup Battery ----- 118 pounds

Miscellaneous Experiments ----- 121 pounds

Gross Weight ----- 675 pounds

KEY PERSONNEL

The National Aeronautics and Space Administration provides over-all direction of the Ranger Project from NASA Headquarters in Washington.

The project is managed by the Office of Lunar and Planetary Programs, which is part of the NASA Office of Space Flight Programs. Key NASA personnel in the Ranger program are:

Dr. Abe Silverstein, Director of the Office of Space Flight Programs.

Edgar M. Cortright, Assistant Director for Lunar and Planetary Programs.

Oran W. Nicks, Chief of Flight Systems, Office of Lunar and Planetary Programs.

Benjamin Milwitzky, Head of Lunar Flight Systems.

The Jet Propulsion Laboratory, Pasadena, Calif., operated for NASA by the California Institute of Technology, is responsible for design and integration of the spacecraft and its scientific payload, and tracking of the spacecraft. Key JPL personnel are:

Clifford I. Cummings, Lunar Program Director.

James D. Burke, Ranger Project Manager.

Allen E. Wolfe, Ranger Project Engineer.

Dr. Nicholas A. Renzetti, Deep Space Instrumentation Systems Manager in the Ranger Program.

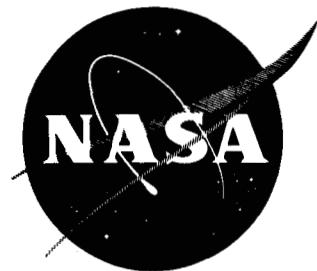
Milton T. Goldfine is in charge of spacecraft launch operations for JPL.

John R. Casani, Ranger Systems Design Engineer.

(Mrs.) Marcia M. Neugebauer, Project Scientist for Rangers One and Two.

Phillip A. Tardani, Operations Manager for the DSIF.

Marshall S. Johnson, Data Operations and Controls System Manager, is responsible for the Ranger operation after injection.



coop *Moon program - gfu*

NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: - UPON DELIVERY

(Expected about 12:15 p.m. EDT)

8:30 PM EDT

RELEASE NO. 61-225

Address by
James E. Webb, Administrator
National Aeronautics and Space Administration

SPACE FLIGHT REPORT TO THE NATION
American Rocket Society
New York, New York
October 11, 1961

* * *

"Our Expanding National Space Program"

Dr. Ritchey, Ladies and Gentlemen:

It is an honor to be at luncheon today with this distinguished group to which the national space program owes so much. The fact that the United States was able to enter the space age four years ago, and that we have come so far since then is, in some large measure, due to the foresight, enterprise, and determination of many of you.

These qualities have been characteristic of the American Rocket Society since its earliest days. Your twelve charter members were thinking far ahead of their times in 1930 when they founded this Society "for promotion of interest in and experimentation toward interplanetary travel."

From the viewpoint of an administrator with responsibility in the space effort, I find it interesting that now, as in the beginning, the American Rocket Society has non-scientists active in its membership. As many of you know,

prime movers in establishing the American Rocket Society were such men as the amateur experimenter and prominent public relations counsellor G. Edward Pendray.

This kind of interest and participation is important in an organization that has such a key role in an enterprise as vast as space exploration, an undertaking with far-reaching implications for the future of the economy, education, the professions, and for the security and general well-being of our country and all mankind.

I wonder, however, if even the founders of the A.R.S. could have envisioned what would grow out of their "space fan club." Who, thirty years ago, could have believed that by 1961 the Society would have evolved into an organization with thousands of members, drawing its leaders from the most advanced disciplines of science and technology, as well as from fields as diverse as industrial management, Congress, and philanthropic foundations?

During the coming years of the nation's accelerated space program the contributions of the A.R.S. can be even more substantial. On the policies you follow, on your drive and effectiveness, rests much of what the nation will do to lift from the realm of dreams to the area of practical things the goal of manned interplanetary travel that your founders envisioned in 1930.

Members of the A.R.S. know the background and accomplishments of the United States space program and of the National Aeronautics and Space Administration. You know better than I do the importance of our National Booster Program and the scientific yields of the fifty-two earth satellites and the deep space probes that the United States has launched, and I believe you understand and appreciate the perception and courage with which President Kennedy has launched us on a new decade of space progress. You will hear more of this from the Vice President on Friday. As Chairman of the National Space Council, he is our best really big "space booster."

The fact that the 1962 space increases were presented by the President and accepted by the Congress on a bipartisan basis shows that as a nation we can still unite in the face of danger and pull together for the clear national interest. Adequacy in space is certainly one such clear interest.

Perhaps it may not be out of place to say that President Kennedy gave me one of the biggest surprises of my life by asking me to head NASA. I tried to tell him that he needed a scientist, an engineer -- someone thoroughly versed in the space sciences, in rocket technology, in satellites and other spacecraft.

But the President insisted that as he viewed the Nation's problems of space, he could not escape a feeling that they were in reality not just scientific or technical, but of broad national and international policy and of the organization of private and government resources to make policy effective.

He stated his conviction that the national space effort is vitally important -- a long-range program which cannot be turned on and off at will. He expressed a strong feeling that, in some large degree, the ability of the United States to achieve its great international goals of peace and fulfillment for all mankind would depend upon what we can achieve in space.

I am here today to report on the actions taken since January 20, and I believe you can accept them as indications of progress.

Based on careful studies made as to military, civilian, and international needs by the senior officials of the Department of Defense, the Atomic Energy Commission, and the National Aeronautics and Space Administration, a program was worked out to develop, build, test, and fly space boosters large enough to accomplish a manned exploration of the moon, and to expedite work in the entire space field. The necessary increases in such areas as space science and technology were incorporated. Plans for the necessary spacecraft, launching, testing, tracking, and recovery facilities were added. The program was examined by the Space Council under the leadership of the Vice President and presented to the Director of the Budget and to the President. Both Majority and Minority leaders on the Senate and House Committees were consulted by the Vice President and the Space Council.

On May 25, the President presented his recommendations for a start on the long-range program to the Congress as a matter of urgency, but as one on which the Congress itself should decide. This Congress did, as I am sure you know, by authorization and by substantial appropriations. But

Paul D. you may not have followed the details sufficiently closely to know that there was a reduction in appropriations of 112 million dollars, and that it was only the day before adjournment that we obtained the necessary flexibility in fund transfers and excepted positions to organize the effort effectively and efficiently.

As soon as it became clear that Congress would approve the program a series of actions were initiated to start the forward motion.

Planning Through three massive computer runs, 2,200 discrete tasks were analyzed using the performance evaluation and review technique to determine that manned lunar exploration was feasible in the 10-year time period.

On the third run we found an acceptable course of immediate action and have initiated a large number of steps to bring it to fruition. However, it is important to recognize that a number of problems are unresolved and await further research and technological advance.

With respect to the utilization of solid propellants or liquid propellants in our largest boosters, we are carrying out development of both for such period as is required to make the necessary evaluation.

With respect to the possibility -- for our most advanced missions -- of building a large space ship out of components placed in orbit around the earth by medium-sized rockets, as against the advantages of using a giant-sized booster of the Nova class, we are proceeding with the necessary fact-finding. We are incorporating in our decisions on programs and facilities the flexibility that will permit us to take advantage of either these or other proposed methods for accomplishing our goal.

We have not subordinated our work in space science to the man in space program, but have instead increased it as a necessary first step in all our programs.

We have not reduced our program for research on scientific and technological problems associated with space which can be conducted here on earth, but have rather increased it where this was the most efficient way to accomplish the desired result.

We have not reduced our work in the areas of aeronautical research and the study of atmospheric flight, but have rather increased and extended it to determine every area in which gains for the space program as well as for manned flight in the atmosphere could be obtained.

We have not instituted what is sometimes called a crash program, but have proceeded at a fast pace through the orderly processes of government, including Congressional examination. We have worked in close coordination with the Department of Defense, the Atomic Energy Commission, the State Department, the Federal Communications Commission, the Department of Commerce, the National Science Foundation, and indeed, all agencies with interest in participation.

We have followed the policy of using existing resources of the nation in such outstanding organizations as the Air Force, the Army and Navy, the Weather Bureau, the Atomic Energy Commission, the National Bureau of Standards, and in universities and industry. We have refrained from jurisdictional bickering.

The results, I believe, speak for themselves.

With respect to the ongoing flight program, we have conducted 11 launches so far during 1961, of which seven were successful. We have conducted not only the first animal and manned suborbital flights, but have gone far to prove the Mercury-Atlas system with a successful unmanned orbital flight and recovery. Perhaps I might also be permitted to mention the following: We have launched the third weather satellite, TIROS III, which reported the daily position of hurricanes and was responsible for the discovery of Hurricane Esther two days earlier than would have been possible by other methods. Among the scientific satellites were Explorer XI which is sending back data on gamma rays emitted from various parts of the heavens, and Explorer XII which is surveying energetic particles over a highly elliptical trajectory varying from less than 200 to nearly 50,000 miles above the surface of the earth.

In the build-up for our national launch vehicle program, we have planned, financed and proceeded to procurement on the newer Saturn configurations to increase performance of the Saturn C-1, and have moved a long way toward fixing the configuration for Nova.

In the Unmanned Space Flight Program, we have added four vehicles to the Ranger series, have scheduled a Mariner flight toward Venus during its next approach to the earth, and have had such successes as those previously mentioned. We have also had our failures but there has been no diminution in the pace of the advance.

With respect to our worldwide tracking facilities, they have been substantially completed and proved out by such flights as the unmanned orbital Mercury-Atlas flight last month. The communications networks and the computer and operational capabilities of our data acquisition, storage and use facilities have met our requirements. We have demonstrated that this worldwide tracking communications and data acquisition network is a priceless national asset.

The backbone or basic structure of the facilities we will need for the research and development associated with manned space flight; and for the fabrication, static test, and launching of either the very large Nova rockets or a larger number of medium rockets, have been planned, locations selected, and arrangements made in most cases for construction and operation. This will permit not only the efficient fabrication and use of the large Nova rockets, if required, but the alternate use of a number of medium-sized rockets in the rendezvous technique to build spacecraft in orbit. Further, it will facilitate bringing into being an efficient transportation network, linking our facilities, which will be capable of handling very large rockets in the proper manner and at the times required. A study of the operating problems and the requirements for efficient use of launch and other facilities in this large and varied program demonstrates the need for linking the fabrication, static test, and launch facilities by such a transportation complex.

With respect to the applications through which space science and technology can begin to yield useful benefits, public policy has been established to speed up a worldwide operational system for communications based on relay satellites. Three important research and development projects have been instituted. These are Project Relay, being developed for NASA by the Radio Corporation of America; the TSX satellite program, through which the American Telephone and Telegraph Company is applying its own resources at its own expense to contribute to an early operational

capability; and the SYNCOM satellites, utilizing the resources of the Hughes Aircraft Company.

All these projects are being carried out in the closest association with the Federal Communications Commission and other interested government departments, as well as with the organizations and interests in other nations concerned in international communications. The principle of privately regulated operation by a grouping of the present carriers has been endorsed, and a strong effort is being made to implement it. However, complete reservation of foreseeable governmental interests has been made. Governmental needs include those relating to international cooperation, worldwide availability of service, and such military needs as can be fulfilled through the use of common carriers.

Arrangements have been made to keep a TIROS weather satellite in orbit at all times until a follow-on system, operated by the United States Weather Bureau, is brought into being. 7

At the President's request, Congress has appropriated funds for the Weather Bureau to initiate the Nimbus satellite meteorological network. This was accomplished only a day or two before the end of the past session. It provides for a major step forward. Meanwhile, an international conference of all nations interested in participating in this new worldwide weather satellite system has been called. It will be held within the next few weeks.

The U.S. Navy has made a large step forward in the applications field through the successful launching of the Transit navigational satellite. Arrangements are now being considered to utilize Transit capabilities to meet the navigational requirements of commercial airplanes and ships.

When I first went over to the State Department in 1949, Bob Lovett cheered me up considerably when he told me that trying to effect a reorganization would be like performing an appendectomy on a man carrying a heavy trunk up three flights of stairs.

The organization problems of the new program in the Space Administration have been no less acute. However, in the past eight months -- based largely on the splendid organizational work and careful studies made by the first NASA Administrator, Dr. Keith Glennan -- we have

established a pattern that is at one and the same time practical and flexible. It takes account of the best abilities of our senior people, establishes strong leadership in our Research and Operational Centers, makes authority and responsibility run together, and provides for a sensitive but effective command and control of the resources required in our space program. You may be interested to know that it also incorporates certain self policing factors that even auditors and accountants and efficiency experts should appreciate.

We have divided our work into four major program categories: 1) advanced research and technology in aeronautics and space; 2) the scientific study of the space environment and celestial bodies by instrumented unmanned satellites and space probes; 3) the applications of earth satellites to such immediate uses as weather observation, global communications, and navigation; and 4) the exploration of space by man. Program directors, within a particular program area, have over-all responsibility for projects, establishing technical guidelines, budgeting and programming funds, scheduling each project, and evaluating progress.

The directors of NASA's research and development centers report directly to the Associate Administrator, Dr. Robert C. Seamans, Jr., and thus have an increased voice in policy making and program decisions.

No statement about aeronautical or space research, or NASA would be complete without a tribute to one of your most distinguished members who is also a member of the National Academy of Sciences. I refer, of course, to Dr. Hugh Dryden.

My first request in my first talk with President Kennedy, speaking for myself and for Vice President Johnson, was that Dr. Dryden be urged to remain as Deputy Administrator. The President enthusiastically agreed, and in planning and carrying out the actions I have described, the judgment and knowledge of this able and devoted public servant has been a main reliance, both in the Executive Branch and in the Congress. As Deputy Administrator and Associate Administrator, he and Dr. Robert Seamans share with me all the burdens and pleasures of NASA's decisions, the building of its team, its successes and its failures. NASA is not a one-man organization and it is decisive and fast-moving.

Each of us respects the other and expects to do his part, using his best talents to continue to press on with our part of the nation's space effort. No one could have finer or more able associates.

Thank you very much.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

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5:30 P.M. EDT

RELEASE NO. 61-226

Remarks at Opening Ceremonies
"Man In Space" Exhibit
American Museum of Natural History
New York, New York

October 11, 1961

James E. Webb
Administrator
National Aeronautics and Space Administration

PRESIDENT WHITE, LADIES AND GENTLEMEN:

It is a great pleasure to be here to open this Man in Space Exhibition. The occasion marks a significant milestone, for it was here on October 12, 1951, ten years ago tomorrow, that the American Museum of Natural History was host to the first symposium on space travel ever held in the United States.

In this ten years, our country and the world have moved into an entirely new era of thought and action. In 1951, the conquest of space by man was still a dream. Sounding rockets, primitively instrumented and guided, were the only probes we had sent into the vast unknown surrounding the earth. They returned only the simplest of data.

In the four years since space flight was first demonstrated, man has made and sent devices into space which orbit the earth and reach out to the sun and planets to radio back immeasurable additions to our store of knowledge. He has

also sent the first of his fellow beings into space and brought them back safely.

This hall, which houses the Man in Space Exhibit, was given by the State of New York as a memorial to Theodore Roosevelt. It was dedicated by Franklin Delano Roosevelt. These two great presidents, of different political parties, each had a zest for exploring the unknown, and a deep faith that men, working through their governments, as well as other institutions for cooperative action, could effectively overcome the problems of their time. Both would certainly join wholeheartedly today, could they be here, in wishing every success to the bold enterprise which this exhibition portrays -- that of insuring that the United States of America is first in space science and technology.

When you examine the exhibit here, you will see that the exploration of space is a step-by-step process. Such problems as weightlessness, radiation, extreme heat and cold, and the stresses of acceleration and vibration to which spacecraft are subjected when they fly in space and exit and return through the earth's atmosphere at enormous speeds are no longer fearsome unknowns. But we still have much to learn about them in our struggle to master manned space flight. As you will see in this exhibit, new technology in energy use, in electronics and communications, in new materials and in life support systems is the foundation for our efforts to enable man to carry with him an operable environment into the hostile realm of space. It is not enough to survive. Man is going into space to do useful work in the cause of all mankind, and the conditions required for useful work in space are formidable indeed.

In the past ten years this Museum, through its Department of Astronomy, the American Museum Hayden Planetarium, has sponsored other symposia, exhibitions, and educational programs in the space sciences. This has been done to develop general awareness of the importance of space exploration and to create an informed public prepared to participate wisely in national space decisions.

We at the National Aeronautics and Space Administration are, of course, delighted to see such an exhibit as the one surrounding you, which is concerned almost entirely with the biological problems of manned space flight. The National Museum of Natural History deserves the highest praise for its continued interest in this field.

In considering the importance of the most advanced technology to manned space exploration, and the use of men in the discovery and analysis of the forces of nature at work in the vast areas beyond the earth's atmosphere, a nice balance must be struck between the means used to attain velocities upward to 25,000 miles per hour, the accelerations and other forces tolerable by man, and the invention of protective and adaptive means to accomplish the seemingly impossible.

Rocket systems can permit only 5 to ten percent of their weight in structure. They require 90 to 95 percent in fuel. Every additional pound in a low earth orbit costs ten pounds in the booster system. Every pound boosted to the surface of the moon requires more than 150 pounds of fuel and structure in the rocket to provide the added thrust to escape the earth's gravity. Boosting man into space enclosed within an environment that allows useful work stretches to the limit practically every technology our scientists and engineers have developed.

Every item of equipment you will see today will prove our ingenuity in advanced technology and will also speak eloquently of the tremendous rate of change that is taking place in every field.

When we turn from technology to man himself, we recognize immediately that we cannot re-engineer the human being. Man cannot be tailored to fit space exploration. He must have oxygen to breathe, be provided pressure similar to that on earth, as well as temperature and humidity that he can tolerate. Provision must also be made for elimination of carbon dioxide and other toxic agents. He must be protected from radiation and other hazards. He must learn to live with

weightlessness, or we must find a way to counteract it. Psychologically he must conquer such factors as isolation, confinement, detachment, the threat to life, and even the contemplation of never returning to earth.

In short, the whole area of the life sciences, the study of man himself, must be married effectively to the most advanced work we are doing in the physical sciences and in technology.

The National Aeronautics and Space Administration has two Man in Space programs. They are Project Mercury and Project Apollo.

Project Mercury is designed to put a manned satellite in orbit at an altitude of more than 100 miles, circle the earth three times, and then bring it back safely. As most of you know, two manned suborbital flights carrying Astronauts Alan Shepard and Virgil Grissom have already been made. The first manned orbital flight is planned for late this year or early in 1962.

Project Mercury was designed to tell us how man will react to spaceflight, how he can perform in a space environment, and what should be provided in future manned spacecraft to allow him to function usefully. Equally important, of course, is the technical knowledge which Project Mercury will give us about the design, construction, and operation of the first U. S. vehicle specifically engineered for manned spaceflight.

From the viewpoint of the astrobiologist, the flights of Shepard and Grissom were intensely interesting, although of short duration, each about 15 minutes. During these 15 minutes both Shepard and Grissom carried out in the spacecraft the tasks that were assigned to them, including attitude control and correction and deceleration rocket firing.

Each was subjected to about five minutes of weightlessness and found this no handicap in performance of duties.

Each endured, without harmful results, gravity forces six times his own weight due to the accelerations of rocket launch, and eleven times his own weight due to entry decelerations. Both were in constant voice communication with the ground.

The physiological reactions of both men before, during, and after the flight, did not materially differ from reactions shown during earlier ground tests.

The second step in the NASA manned space program is Project Apollo, designed to lead ultimately to a three-man expedition to the moon. Apollo will require space techniques far in advance of those needed for Mercury. Apollo must be built to withstand a much greater launch thrust. It must be capable of guidance toward the moon and it must be able to land gently on the moon, then be launched from the moon and guided back for safe return into the earth's atmosphere at the fantastic speed of 25,000 miles per hour.

The Atlas booster for the Mercury launching produces some 360,000 pounds of thrust. The launch vehicle for Apollo must develop 30 to 50 times as much. Apollo will require self-contained power systems for course correction, landing on the moon, for the launch back to earth, and for a controlled landing on the earth.

Like other achievements in space, the Apollo flights must be a step-by-step process. The spacecraft will first be flown in orbit around the earth so that the many components and systems of the vehicle can be tested and evaluated.

These earth-orbiting flights will also be used for training the space crew and for development of operational techniques. Each will also include important scientific experiments.

As the competence of the Apollo vehicle and the men who will operate it increases, the flights will go farther and farther from earth, and will be of longer duration and complexity. A major step will be a manned flight around the moon, on which the crew will perform many of the guidance and control tasks that will be needed later on in the lunar landing mission.

In constructing Apollo, a modular concept will be used. That is, the spacecraft will be divided into compartments or units, each designed as a complete subsystem to accomplish a complete function.

The first compartment will be the "command center module." It will house the crew during launch and entry and serve as a flight control center for the remainder of the mission.

The second module is a propulsion unit. It will be capable of making mid-course corrections, of putting the spacecraft into whatever orbit the mission calls for, and of providing the power needed for the return flight of a lunar mission.

In an advanced version of Apollo, a third module will be an additional propulsion stage to decelerate the spacecraft as it approaches the moon and lower it gently to the moon's surface. On other missions this module, or perhaps even an additional section, would serve as a laboratory for various space experiments.

The launch vehicle for Apollo's earth orbit and circumlunar flights will be Saturn, while a giant clustered booster called Nova -- which will develop 12 million or more pounds of thrust -- is planned for the lunar landing flight.

No launching schedule has been established for a manned lunar landing. However, President Kennedy has stressed his view that "this Nation should commit itself to achieving

the goal, before the decade is out, of landing a man on the moon and returning him safely to earth." How much sooner we will be able to accomplish this cannot be determined just now. We are going to proceed toward the goal as rapidly as possible. As soon as we can make the attempt, we will.

There is no doubt that dramatic and important space achievements which demonstrate a very advanced capability in science and technology have a tremendous impact on world opinion. This is an important consideration in our program and we are increasing our efforts to acquire a space capability second to none.

However, this is by no means the only consideration. Included in NASA's 10-year program goals are: (1) exploration of space to gain scientific knowledge; (2) practical applications of advances in space technology for the benefit of the people of our country and those of other nations; (3) advancement of technology on a broad front to meet the diverse requirements in the fields of aeronautics and space; (4) development of launch vehicles, spacecraft, supporting technology and facilities to meet future needs for manned and unmanned space exploration; (5) cooperation with and support of other Government agencies whose functions and responsibilities relate to those of NASA; (6) cooperation with other nations in the exploration of space.

Since January 31, 1958, this country has successfully launched 52 earth satellites, two solar satellites, and two deep space probes. These have furnished a wealth of information to science and to our knowledge of the requirements for manned space flight.

NASA's Echo I passive communications satellite, launched in 1960, has been seen by millions of people throughout the world. The huge, aluminized plastic sphere proved that it is possible to communicate between distant areas on the earth by reflecting radio signals from a satellite.

NASA's TIROS series of meteorological satellites has demonstrated the possibilities of vastly more accurate and longer-range weather forecasting. TIROS I transmitted nearly 23,000 television pictures of the earth's cloud patterns. TIROS II, launched last November, has transmitted more than 40,000 pictures and has reported important information about the atmosphere and the radiation of solar heat back from the earth.

TIROS III pictures of Storm Eliza in the Pacific and Hurricanes Esther, Anna, and Carla on the Atlantic and Gulf Coasts were valuable aids to the Weather Bureau in tracking these cyclonic winds and issuing warnings. NASA also used TIROS III for weather support of Astronaut Grissom's July 21 Mercury suborbital flight.

Advanced launch vehicles are becoming available to us for both scientific missions and for operational systems. They will have greatly improved load-carrying capability for the unmanned space experiments which must precede extensive manned flights. Good examples are the programs for Ranger which will land instruments on the moon, and Surveyor, a spacecraft that will be able to make a so-called "soft landing" on the moon with more delicate scientific instruments. Also under development are spacecraft that will fly close to Venus and Mars.

Already the national investment in space exploration has produced new materials, metals, alloys, fabrics, and compounds which have gone into commercial production. From work in space vacuum and extreme temperatures have come new durable, unbreakable plastics and new types of glass that will have a wide variety of uses.

Medical scientists in the space effort have devised minute sensors to gauge an astronaut's physical responses, to measure his heartbeat, brain waves, blood pressure, and breathing rate. These same devices are now being attached to hospital patients so that their conditions can be recorded continuously and automatically at the desk of a head nurse.

More than 3,200 space-related products have been developed in the United States. They come from the 5,000 companies and research outfits now engaged in missile and space work. From this new industry are coming new opportunities and new jobs.

For Fiscal Year 1962, the National Aeronautics and Space Administration has a budget of \$1,671,750,000. This includes \$245,000,000 for construction of new and supporting facilities and \$1,220,000,000 for research and development. Eighty percent of the NASA research and development budget is spent through contracts with industry and private organizations.

The large sums of money required in this effort are not spent in space or on the moon. They are spent in the nation's factories, workshops, and laboratories for salaries, materials, and supplies.

In the time available today, I can only touch the highlights of space exploration, which has been termed "the most challenging adventure man has ever undertaken."

I do want to mention, however, a long-term aspect of the national program that is one of the logical following steps to the theme of the Man in Space exhibit which you will be viewing here today. This is the prospect that we may eventually discover that life is not a phenomenon unique to our planet.

NASA has several projects under way to discover if life, in whatever high or lowly form, may have evolved elsewhere in our solar system. For example, Stanford University's School of Medicine is developing instruments for detecting signs of life on other planets. This equipment will be installed in unmanned devices that we shall in the foreseeable future be landing on the surfaces of Mars and Venus.

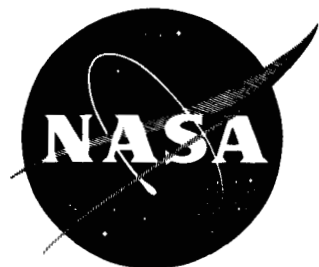
Many scientists believe that the odds favor the existence of life beyond that on earth. At any rate, we have

begun research that will ultimately go far to answer this question. It is within the realm of possibility that, a decade or so from now, the exhibit in this great hall of the American Museum of Natural History may be called, not Man in Space, but Life in Space.

The United States program in space offers us the chance for unparalleled progress. I am convinced that, as a nation, we shall respond boldly and with determination to the call President Kennedy issued when he urged the world:

"To invoke the wonders of science instead of its terrors . . . to explore the stars, to conquer the deserts, eradicate disease, tap the ocean depths and encourage the arts and commerce."

Thank you very much.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
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FOR RELEASE: PM's Monday
October 16, 1961

Release No. 61-227

SCOUT DEVELOPMENT AND IONOSPHERE PROBE EXPERIMENTS

The National Aeronautics and Space Administration will soon launch the seventh in a developmental series of Scout rockets. The Scout is a four-stage, solid fueled rocket under development to provide the United States with a small, reliable and flexible research vehicle for a variety of space explorations tasks.

Coupled with this launch will be a 94 pound payload, P-21, designed to explore the physical phenomena in the upper ionosphere. The ionosphere is a continuum of electrically charged, or ionized regions, beginning some 40 miles above the earth and extending several hundred miles out, gradually merging with outer space.

LAUNCH VEHICLE

Scout is the nation's first solid propellant rocket to place a payload in orbit. It did so on February 16, 1961, when it sent aloft Explorer IX, a 12-foot, aluminum and plastic sphere to collect data on effects atmospheric drag will have on space vehicles and the life of satellites.

Scout is designed to place a 150-pound satellite in a 300-mile orbit or to send a 50-pound scientific package nearly 8,500 miles in a probe shot. For re-entry tests, the rocket can subject a payload to conditions like those encountered by space vehicles returning to the earth's atmosphere. In a ballistic trajectory, it can provide almost two hours of weightlessness for 100-pound experiments.

Scout is 72 feet long and weighs approximately 36,600 pounds. Its four solid-propellant stages consist of Algal first stage, Castor second, Antares third and Altair fourth.

These four rocket motors, plus the necessary transition sections and guidance and control equipment, are assembled into a complete vehicle by the Astronautics Division of Chance Vought Corporation, aerospace subsidiary

of Ling-Temco-Vought, Inc., and prime vehicle contractor for Scout.

Data on Scout's four stages, named for stars in the constellations, include:

Algol - Thirty feet long, 40 inches in diameter, developing 115,000 pounds of thrust. This motor, the largest solid rocket flown in the United States, is fin stabilized and controlled in flight by jet vanes. Developed by Aerojet-General Division of General Tire and Rubber Company.

Castor - Twenty feet long, 30 inches in diameter and developing more than 50,000 pounds of thrust. Stabilized and controlled by hydrogen peroxide jets. A modification of the Sergeant motor, it has been used in a cluster in NASA's Little Joe program in support of the Mercury project. Developed by the Redstone Division of Thiokol Chemical Corporation.

Antares - Ten feet long, 30 inches in diameter and more than 13,600 pounds of thrust. Lightweight plastic construction. Stabilized and controlled by hydrogen peroxide jets. Developed by the Allegany Ballistics Laboratory of Hercules Powder Company.

Altair - Six feet long, 18 inches in diameter and 3,000 pounds of thrust. This motor, formerly known as the X-248 and developed for the Vanguard third stage, is spin stabilized. It is the third stage on the Delta launch vehicle and was the first fully developed rocket to utilize lightweight plastic construction. Also developed by ABL.

Each stage has a burning time of approximately 40 seconds.

Guidance and control system for the Scout was developed by the Aeronautical Division of Minneapolis-Honeywell Regulator Company.

The Scout concept originated in mid-1958 at NASA's Langley Research Center in Virginia and a project office was established to develop the vehicle and serve as program manager. The first full-scale vehicle was launched from Wallops Station, Virginia, on July 1, 1960.

Mid-way in the eight-shot series, NASA named Chance Vought, previously air-frame contractor, as prime vehicle contractor and assigned the Dallas company additional responsibilities extending from initial assembly through preparation of the vehicle for launch.

This placed initial assembly and checkout of the vehicle at the site where the airframe, sections between the stages and other hardware items which go into uniting of the Scout's four rocket motors, are produced and resulted in a significant reduction in the time required for assembly and checkout.

Previously, all Scout components and systems, including the transition section, had been shipped to the Wallops Station, facility where preliminary assembly and checks were performed by NASA with the aid of Chance Vought and other contractor crews.

The next step in streamlining the Scout program will be devising methods which will permit launches from additional sites using simplified checkout and launch equipment and small launch crews.

PAYLOAD - P-21

This eight-sided satellite is part of the Goddard Space Flight Center's P-21 series of four rocket flights to investigate ionospheric characteristics of importance to radio communication, radio tracking and guidance, and to add to the basic understanding of the earth's ionosphere.

In the ionosphere, incoming radiations from the sun collide with atoms of gases, releasing free electrons and positive ions, creating reflective layers for radio signals. If it were not for the ionosphere, long range radio communication would not be possible, and lethal radiations from the sun would not be absorbed, drastically altering life as we know it on the earth. Ionospheric data is very scarce between 200 miles and 600 miles, and virtually non-existent above the latter altitude. Significant results could be obtained if only half the planned altitude is achieved.

Two probes have already been fired this year in the series. On April 27, an Argo D-4 rocket reached an altitude of 450 miles and gave an excellent profile of electron densities during mid-day, for a quiet ionosphere. Another D-4 was fired in June to compare nighttime/electron densities with the daytime data obtained previously, but a rocket failure kept it from achieving its objectives. The upcoming Scout firing, which will take about one hour to reach peak altitude of about 4500 miles, will measure daytime electron concentration. It will impact in the Atlantic Ocean about 3900 miles from the launch point. No effort will be made to recover the payload. Another Scout early next year will chart the nighttime profile.

Experimentation

The P-21 will contain two scientific experiments to measure electron density and associated ionospheric character-

istics. One is a continuous wave (CW) propagation experiment for the ascent part of the trajectory. The other is a swept-frequency probe for the upper part of the trajectory and the descent flight. A secondary objective of the launch is to test the ability of a new Dovap (Doppler Velocity and Position) facility at Wallops Station to monitor high altitude flights. Previously, the station has been used to track rockets with altitudes of less than 600 miles.

In the CW experiment, two radio signals are transmitted from the rocket to a receiving station on the ground, at frequencies at 12.267 Mc (one watt power) and 73.6 Mc (0.5 watt power). The higher frequency is essentially unaffected by the ionosphere and will provide a reference with which to compare the low frequency transmission. The lower frequency will be affected considerably by the physical conditions of the ionosphere, with the effects being detected and recorded at an ionosphere ground station located on Wallops Island.

The radio frequency impedance probe measures the ionospheric electron concentration by direct sampling. It accomplishes this indirectly by comparing the measured capacitance of a sensor to its free-space value. These data can then be related to the dielectric constant of the region, and thus to the electron concentration surrounding the probe. The sensor is a parallel-plate capacitor having two circular wire mesh discs 15 cm in diameter with a 1.5 cm separation. A radio-frequency voltage is applied across the capacitor at varying frequencies. The impedance, or resistance of the capacitor is monitored by measuring the flux in the transformer supplying the voltage.

Flight Information

Total payload weight is about 94 pounds. This includes the scientific payload, the environmental test package for the Scout, and balancing weights. The instrumentation package will not be separated from the fourth stage, but the nose cone (heat shield) will be released at third stage ignition. Antennas will be deployed 95 seconds after third stage ignition. Launch angle will be about 85 degrees.

Flight data will be recorded at the Goddard Space Flight Center's ionosphere ground station at Wallops Island, and at another station at Blossom Point, Maryland. FPS-16 radar at Wallops will be used to evaluate vehicle performance during powered flight, and radar installations at Millstone Hill, Massachusetts; Trinidad, B.W.I.; Bermuda; and the MIT (Lincoln Laboratories) installation on Virginia's eastern shore will skin-track the vehicle.

The Ionosphere Sounding Station at Wallops Island

and Ionosphere Stations at Ft. Belvoir, Virginia, and Patuxent River, Maryland will supply ionosphere data before, during, and after the flight.

Project Participants

NASA Headquarters Program Manager for the developmental Scout program is R. D. Ginter.

Langley Research Center has sole responsibility for the direction of the developmental Scout launch vehicle. George R. Rupp is the Scout Program Director for Langley Research Center.

Chance Vought Corporation is the prime contractor for the Scout vehicle.

NASA Headquarters Program Manager for the P-21 is M. J. Aucremanne.

Goddard Space Flight Center has the primary responsibility for designing the experiments and the major electronic components and payload sensors for the P-21. The GSFC Payload Manager is John E. Jackson.

Raymond Engineering Laboratory, Inc. designed and built the structure in which the payload instruments are housed. The company also furnished antennas and built the grid structures used to measure electron density.

Washington Technological Associates is supplying Technical personnel to operate the ionosphere ground station at Wallops Station.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: Monday PM's
October 23, 1961

Release No. 61-228

NASA BUYS ADDITIONAL DELTA LAUNCH VEHICLES

The National Aeronautics and Space Administration today ordered 14 more Delta launch vehicles.

The order, estimated to cost a total of \$19 million, was placed with Douglas Aircraft Company, Santa Monica, Calif., developer of the Delta. The 14 Deltas are in addition to the 12 originally produced for NASA by Douglas under an April, 1959 contract.

Most of the vehicles will be used to launch communications satellites -- NASA's Relay and Syncom active satellites and the American Telephone and Telegraph Company's Telstar satellites. Several will be used for Tires meteorological satellites. In addition, NASA recently announced that the first United Kingdom satellite S-51 would be Delta-launched.

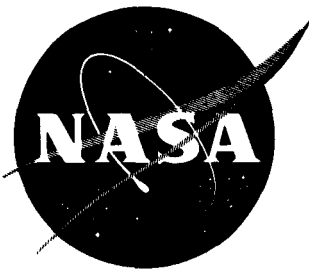
The Douglas Thor first stage will be powered by an improved Rocketdyne engine developing 170,000 pounds thrust.

Upper stages are an Aerojet-General AJ10-118 liquid stage of about 7,500 pounds thrust and an Allegany Ballistics Laboratory ABL-248 solid propellant third stage of about 3,000 pounds thrust. The guidance system is by Bell Telephone Laboratories.

Today's contract was signed for NASA by its Goddard Space Flight Center, which has technical supervision and launch responsibility for the Delta Program.

Six of the original 12 Deltas have been launched. The first failed to carry an Echo passive communications satellite in orbit in May, 1960, but the succeeding five Deltas successfully completed their missions. They orbited Echo I, Tires II and III, and Explorers X and XII.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: UPON DELIVERY
8:30 p.m. EDT

RELEASE NO. 61-229

Address by
James E. Webb, Administrator
National Aeronautics and Space Administration

THE TWENTIETH AMERICAN ASSEMBLY
Arden House, Harriman, New York
October 19, 1961

* * *

"Initiative and Responsibility
in the Study and Use of Space"

Dr. Wriston and Members of the American Assembly:

On previous occasions in this hall, it has been my privilege to sit before a speaker who was prepared to set the stage for a vigorous rubbing of minds on an important national subject and to help establish guidelines for discussion.

Tonight the situation is reversed. As I look about and see so many men who have made such important contributions to the surging advance of science and technology as it relates to space, I have a feeling that rather than stand here at the beginning of this Assembly, I should sit with you at the end to assimilate the results of your discussions. Nevertheless, I will do my best.

It may not be amiss to begin with the fact that our national program for the exploration and utilization of that vast medium to which we apply the term "space" involves action as well as philosophy and policy. Indeed, in many cases, we cannot choose our actions free of pressures beyond our control.

Many important actions have been taken since the passage of the National Aeronautics and Space Act in 1958. Others are now in preparation, and it will be my purpose tonight to show that these actions form for our nation a pattern of initiative and responsibility, as well as responsiveness to a deeply felt need of the American people.

As background for my discussion, and your own in the days ahead, you have received a splendid perspective from your editor, Lincoln Bloomfield, in his paper, "The Space Revolution."

He points out that while this revolution "is essentially still in the hands of a small elite" who "may and do propose, the people, in the last analysis, will dispose."

Making clear his view that "in the end the problem of outer space is a problem of human values" and that beyond the national arena "the conquest of space is an opportunity for statesmen to build their structures in a still relatively uncluttered area of interaction between the nations" he cites "the lag between scientific technology and the human capacity to maximize its benefits and minimize its harm through social, economic, and political arrangement."

In my view, Mr. Bloomfield practices the realism for which he calls when he states that "the question of ultimate public support remains before us, along with virtually all the grand issues of public policy." The "grand issues" may take longer, but in some large measure, the question of public support will be answered as Congress acts on the 1963 Space Budget. The requirements will be substantially larger than in 1962. The openness with which we conduct our operations often seems to emphasize the spectacular nature of such a success as the first manned flight in our Mercury program by Alan Shepard. Whether it turns out to be a success or failure, the launching of the Saturn first stage for its trial flight -- planned to take place within

the near future -- will attract the widest attention and be viewed by millions. Such flights are not stunts. They are not antithetical to sober scientific and technological research. Interpreted properly, these dramatic events can add much to public understanding and excite creative interest in extending the base of knowledge on which public support must rest.

But public support depends upon more than interest and understanding. The method of presentation, as well as the substance of the program, is important. The fact that President Kennedy's request for increases in the 1962 Space Budget were presented on a bipartisan basis and were so accepted by the Congress shows this.

From the beginning of my meetings with him on space questions, President Kennedy has viewed our problems as not solely scientific or technical but as questions of broad national and international policy and of the organization of private and governmental resources to make policy effective. He has regarded an adequate national space effort as vitally important to the United States, and as a long-range program which cannot be turned on and off at will. He has often expressed a strong feeling that the ability of the United States to achieve its great international goals of peace and fulfillment for all mankind depends to a large degree upon what we can achieve in space.

No discussion of our national space effort and of the kind of public support that it must justify and retain over an extended period would be complete without some indication that to the person with little or no space background, the man or woman going about daily tasks, reading and hearing about manned orbital flight, manned exploration of the moon, or the great radiation belts, space is almost beyond comprehension. It is an entirely new and different sphere. It is separated by a wide gap from normal experiences, the things we know from our eyes, ears, hands, and other senses. One of the greatest tasks of space leadership is to find ways to bridge this gap.

Before this group, it is not necessary to compare the fifty-eight years of man's powered flight in the atmosphere with the four years since man proved his ability to achieve space flight. Nor is it necessary to linger over the fact

that in the United States, where they took place, experimental demonstrations by the Wright Brothers in 1903 that powered flight was feasible and in 1926 by Dr. Robert Goddard that rocketry was practicable, were received with indifference or scorn. Here, these harbingers of the future were so neglected that the first utilization of the lessons learned were exploited abroad.

In aviation, we learned this at our grave risk during World War I but built our position in the inter-war years.

In rocketry it took a dozen years after the V-2 experience of World War II, plus the demonstrated rocket competence of the USSR, to crystallize our policy, programs, and organization into a national space effort.

The lead time of 45 years, from the Wright Brothers to jet performance in aircraft, is one measure of the technical achievements required in such matters. To accomplish all that must be done to achieve a manned lunar expedition within a span of ten years will require every possible acceleration in technological advances and their application. Research and development in direct and in supporting areas must be pursued to the utmost of our abilities, without let-up.

Although long lead times are hard to explain in bidding for and retaining public support, there is nevertheless no avoiding them in space work.

I believe it is clear from the papers prepared for this Assembly, that in the period since the National Aeronautics and Space Act was passed in 1958, and as a result of strong pressures to step up our national effort, a substantial space program has been set in motion. The year 1958 marked the culmination of vigorous debate on space policy, just as such a culmination had come in 1946 in the atomic energy field. In the one case, the result was the establishment of the National Aeronautics and Space Administration and, in the other, the Atomic Energy Commission.

In each case, important military developments and uses were reserved to the Department of Defense. In both cases, however, national policy was founded and oriented toward development and utilization of science and technology to

the greatest possible extent for peaceful purposes. Significantly, in both fields the policy of the United States has emphasized benefits to be obtained not only within our own country but also in implementation of our international policy to assist other nations in economic, political, and social growth toward democracy and self-determination.

The United States has made major efforts to limit the destructive potential of nuclear fission and to find ways and means to expand its constructive use to solve the problems of mankind.

The same policy has been followed with respect to our space effort.

In the 1958 Space Act, among the basic policies written into law were:

"...that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

"...that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. ...that such activities be the responsibility of... a civilian agency..., except... activities peculiar to or primarily associated with the development of weapons systems, military operations, or... defense... and that determination as to... responsibility for... such activity shall be made by the President..."

"That aeronautical and space activities be conducted so as to contribute to:

- (1) The expansion of human knowledge of phenomena in the atmosphere and space;
- (2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;
- (3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

- (4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;
- (5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;
- (6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency.
- (7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and
- (8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies in order to avoid unnecessary duplication of effort, facilities, and equipment.

To make these policies effective the 1958 Act provided that the National Aeronautics and Space Administration would:

- (1) Plan, direct, and conduct aeronautical and space activities;
- (2) Arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations; and

- (3) Provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Expenditures for the first full year by the National Aeronautics and Space Administration (Fiscal Year 1960) were four hundred and one million. For the second full year (Fiscal Year 1961), they were seven hundred and sixty million. And for the current Fiscal Year (1962), President Eisenhower, in his final budget message on January 16, 1961, recommended an increase to the level of a billion, one hundred and nine million dollars of new authorizations with an estimated expenditure of nine hundred and sixty-five million dollars.

From all this, it is clear that, between the establishment of the National Aeronautics and Space Administration in 1958 and the end of the Eisenhower Administration, a substantial build-up was already in progress.

During this period in the field of aeronautics, NASA programs were based on a continuation of research, advanced technology development, and flight testing, but with none of the aspects of an operating agency.

In astronautics, however, during these three years implementation of a ten-year plan was begun, under which NASA would carry out not only research and design but all other aspects of an operating agency, such as procurement, launching operations, and data collection and evaluation.

The four major fields to be covered in the ten-year plan were: scientific satellites, lunar and planetary exploration, application satellites (in such areas as weather and communications), and manned space flight. Analysis and publication of the data in each of these fields was programmed.

Under the ten-year plan, the two outstanding space missions projected for 1961 were to be the suborbital flight of an astronaut and a manned orbital flight.

The 1962 mission milestones were considered to be an impact landing of instruments on the moon, advances in planetary spacecraft, and launching of a prototype active communication satellite.

In 1963 there were to be a soft landing of instruments on the moon and the first launching of a three-stage Saturn C-1, having over a million and one-half pounds of thrust.

Nineteen Sixty-Four was to be signalized chiefly by an orbiting astronomical observatory and an unmanned planetary reconnaissance.

For 1965, the major milestone was to be a prototype-capsule test for Apollo, which was conceived as a three-man, earth orbiting laboratory and also as a basic vehicle for manned exploration of the moon.

For 1966, extending through 1970, the original plan called for first flights by the three-stage Saturn C-2, having more than twice the payload of the C-1 in a near-earth orbit as a result of the added stage -- the nuclear rocket Rover -- for a spacecraft in a planetary orbit, and for a manned Apollo earth-orbital flight and a manned Apollo circumlunar flight.

The manned lunar landing mission was considered to lie beyond 1970.

A reasonable estimate of expenditures to accomplish this ten-year plan, as it was laid out at the beginning of 1961, would lie between twenty and twenty-five billion dollars.

One of the important decisions voiced by President Eisenhower in his submission of the Fiscal Year 1962 budget was elimination of funds to press forward under the ten-year program with the large rocket boosters and with long lead-time work on Apollo. This meant that the manned lunar landing, (programmed to come after 1970) could not, in fact, take place under the most favorable circumstances before about the middle of the 1970's.

Mr. Eisenhower's words in his budget message were: "Further testing and experimentation will be necessary to establish whether there are any valid scientific reasons for extending manned space flight beyond the Mercury program."

Within two months and four days after the inauguration of President Kennedy, the United States launched five satellites -- one Explorer, two Discoverers, Samos II, and Transit 3-B. Within the same period the Russians launched three

Sputniks -- VII, VIII, and IX -- and a Venus probe.

Concurrent with these operations, an intensive study was going on under the direction of Vice President Johnson, with the active participation of such senior officials as Defense Secretary Robert McNamara, Atomic Energy Chairman Glenn Seaborg, NASA Deputy Administrator Hugh Dryden, and myself.

On March 24, President Kennedy announced that the key to retrieving our position in space lay in determining that we could no longer proceed with the Mercury one-man space ship as if that were to be the end of our program but that we must, even in a tight budget situation, commit ourselves to build giant boosters. He submitted a request for an additional \$125,670,000 to speed up the Saturn C-2 booster and the large million-and-a-half-pound-thrust F-1 engine.

One day later, March 25, the United States launched its sixth satellite of the year, Explorer X, and the Russians launched their fourth Sputnik of the year, Sputnik X. Two weeks later, April 12, the Russians accomplished a manned orbit of the earth with Cosmonaut Gagarin, in the space ship Vostok.

In the two months following the March 24th decision of the new Administration to step up the big booster program in order to provide lift for larger and more advanced spacecraft, an intensive analysis of every facet of the program was conducted and the reorganized National Aeronautics and Space Council, under the leadership of its Chairman, Vice President Johnson, came increasingly into play. As a result, on May 25, the President announced major new goals for the nation in space and new programs to achieve them.

The President requested that appropriations for the National Aeronautics and Space Administration be increased to \$1,784,000,000, or by about 61 percent, but Congress reduced this by about \$112 million. It is an interesting fact that while NASA spends about 80 percent of its funds through contracts, requiring outstanding technical and management ability to handle these contractual relationships, the most serious cuts were in these areas where the funds were needed most. In this second request the President asked increases for big engines and big boosters aggregating \$144 million. He included in his request an

additional \$130 million for Apollo. Sixty-six million dollars were earmarked to speed exploration of the environments of the earth and of the moon, and the space between. President Kennedy requested funds for studies of the problems of spacecraft returning to earth from flights around the moon at atmospheric entry speeds as high as 25,000 miles an hour and for thorough studies of radiation problems, including an analysis of solar activity over the past fifty years in order to predict, if possible, the periods of extreme radiation which manned spaceflight must avoid.

Included also was an item of \$50 million to expedite development of an active communications satellite system and to demonstrate transatlantic television.

The President requested funds for the Air Force to proceed with solid-propellant engines for a Nova vehicle.

An additional \$23 million was provided to expedite the Rover nuclear-rocket engine.

One way of looking at the eight months since January might be to say that the major actions taken by the new Administration to accelerate the national space effort were to initiate a program to accomplish within the ten years of the 1960's approximately the same volume of space research and development, exploration, and beneficial applications as plans of the previous Administration envisioned in about fifteen years.

It is important to note that while the major manned space flight missions and related scientific exploration of space remained in the civilian National Aeronautics and Space Administration, they were speeded up. Large boosters capable of putting heavy payloads into orbit or for use on other space tasks will be built without delay. This means that if military missions are required in the future, the booster capacity will be available.

Let me hasten to add that none of the above has changed the policy of the United States to make every effort to use space for peaceful benefits to all mankind.

Only three weeks ago, President Kennedy urged at the United Nations a policy of "keeping nuclear weapons from

seeding new battlegrounds in outer space."

Proposing that "...as we extend the law on earth, so must we also extend it to man's new domain, outer space," the President stated that "The new horizons of outer space must not be riven by the old bitter concepts of imperialism and sovereign claims. The cold reaches of the universe must not become the new arena of an even colder war."

The President went on to say, "To this end, we shall urge proposals extending the United Nations' charter to the limit of man's exploration in the universe, reserving outer space for peaceful use, prohibiting weapons of mass destruction in space and on celestial bodies, and opening the mysteries and benefits of space to every nation. We shall propose further cooperative efforts between all nations in weather prediction and eventually in weather control.

"We shall propose, finally, a global system of communications satellites linking the whole world in telegraph and telephone and radio and television."

Thus it is clear that the United States is proceeding with a program that can, should the need arise, substantially increase its military capability. At the same time, we are keeping these activities oriented toward peaceful uses and urging the leaders and scientists of other nations to join with us in this vast new area that holds so much promise.

Perhaps another way of looking at the space program is to consider it a ten-year effort to advance science and technology at the most rapid rate possible in the most important fields of energy use; new materials, metals, fabrics, and lubricants; the most advanced electronics and communications; the marriage of the life sciences with the physical sciences; the harnessing of advanced scientific and technological research and development with operational missions, data collection, storage and evaluation; the development of experimental models into practical useful devices; and in general systems management of a high order of efficiency. If this concept is considered in the light of the language of the 1958 Space Act, which calls for the preservation of the United States as a leader in aeronautical and space science and technology and in the

application thereof to the conduct of peaceful activities, the leverage of this program in a growing national economy can be of great significance.

You here at this Assembly are more keenly aware, I am sure, than are most citizens of the fact that in the decade from 1960 to 1970, if we can avoid war, the number of our fellow countrymen requiring food, clothing, and services will rise from one hundred and eighty million to two hundred and thirteen million; that public and private construction will rise from an annual rate of \$55 billion to more than \$90 billion; that more than \$700 billion of construction will be put in place; and that, with the addition of some three hundred to four hundred billions of maintenance and repair, our investment in these capital items will add up to more than a trillion dollars during the period.

The space program is the first that broadly teams the life sciences with the physical sciences, thereby substantially increasing its capacity to feed back benefits in all areas of economic, political, and social growth. Again, the fact that the National Aeronautics and Space Administration is required by the 1958 Space Act, to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof" is of no little significance.

In his thoughtful paper prepared for you, the first Administrator of the National Aeronautics and Space Administration, Dr. Keith Glennan, asks if it is possible to pose specific questions, among them -- "Should our energies and funds be devoted to the accomplishment of a few spectacular shots" or "are not the shorter range objectives of developing useful applications of space technology in the fields of communications, meteorology, and navigation -- activities that promise real benefits to mankind -- equally or even more important as national objectives?" Commenting on these and other difficult questions with respect to what our goals should be, Dr. Glennan gives us the benefit of his experience when he says, "There is a hard decision to be made here."

In my own opinion, there is little doubt that, unless we press forward vigorously in all of these fields, we would see the Russians, with the advantages of their advanced position in booster thrust, stay continuously ahead, and we

ourselves would fail to move forward as rapidly as we could with useful applications to meet our own needs. The cost over the ten years of our accelerated program will very probably be less than if it were stretched out over fifteen years. The benefits will be immeasurably greater. The total ten year cost will be no more than two-thirds of the present cost of one year of our current military program.

The policy of the present Administration is to press forward in all related areas of science and technology at the most rapid rate that can be justified by the state of the art, without involving the wastefulness of crash programs.

A few moments ago, I spoke of the actions that have been taken and of those in preparation as indicating the course which the space program may be expected to take.

This may be more meaningful if we visualize that as soon as it became clear that Congress would approve the program, a series of actions were initiated to start the forward motion.

Two thousand, two hundred discrete tasks were analyzed with respect to possible schedules and probable costs. These elements were fitted into a single master schedule through massive computer runs, using the performance evaluation and review technique (PERT) to determine that manned lunar exploration was feasible within the ten-year period. On the third run, we found an acceptable course along which to initiate action, but it is important to recognize that a number of problems are unresolved and await further research and technological advance.

Work in space science has not been subordinated to the man-in-space program, but has rather been increased and given added emphasis as a necessary first step in all our programs.

Research that can be conducted here on earth on the scientific and technological problems associated with space has been increased wherever this was the most efficient way to accomplish the desired results.

Work in aeronautical research and in the study of atmospheric flight has been increased and extended to determine every area in which gains for the space program,

as well as for manned flight in the atmosphere, could be obtained.

In the field of big boosters, we are proceeding rapidly to a test of the first stage of the Saturn C-1 and have under contract both the S-2 (second) and S-4 (third) stages. Both are based on the very advanced liquid-hydrogen, liquid-oxygen technology, and both will be used in later and larger boosters. Beyond the Saturn C-1 configuration, we are in the final stages of selecting a contractor to build a first stage for an advanced Saturn which will provide a thrust from two to four times that of the C-1, or up to a level of six million pounds.

For very advanced missions requiring the heaviest payloads, the giant Nova booster, with a thrust range of 12 to 20 million pounds, may be required. We are continuing work to develop the basic information to permit a decision as to whether this booster would serve our purposes better if composed of clusters of large solid-propellant engines or the large liquid F-1 engines.

At the same time, we are thoroughly exploring the possibility of building large space ships out of components placed in orbit around the earth by medium-sized rockets such as the advanced version of Saturn. However, until this is proven feasible, we will continue to work toward the building of Nova.

In developing our facilities for launching of rockets at Cape Canaveral and for their fabrication and static test near New Orleans, we are incorporating the kind of flexibility that will enable us to take advantage of either the large rocket systems for a direct ascent to the moon, or of medium-sized systems employing the rendezvous-in-orbit technique, or of other proposed methods of accomplishing our goals.

With respect to advanced spacecraft missions, we have expanded the number of our lunar exploratory Ranger launchings from five to nine, we are undertaking to launch a Mariner spacecraft toward Venus when it is nearest the earth in 1962, and we have received proposals from interested contractors for the development and building of the Apollo spacecraft. We expect to award the contract and begin work before the end of the year.

With respect to the ongoing flight program, we have conducted not only the first animal and manned suborbital flights, but have gone far to prove the Mercury-Atlas system with a successful unmanned orbital flight and recovery.

Also among our successful launches was the third weather satellite, TIROS III, which reported the daily position of hurricanes and was responsible for the discovery of hurricane Esther two days earlier than would have been possible by other methods. Among the scientific satellites launched this year were Explorer XI, which is sending back data on gamma rays emitted from various regions of the sky, and Explorer XII, which is surveying energetic particles over a highly elliptical trajectory extending from two hundred to nearly fifty thousand miles above the surface of the earth.

We have also had our failures, but we have learned from each of them.

With respect to our worldwide tracking facilities, they have been substantially completed and tested by such flights as the unmanned orbital Mercury-Atlas flight last month. The communications network and the computer and operational capabilities of our data acquisition, storage and use facilities have met our requirements. We have demonstrated that this worldwide tracking communication and data acquisition network is a priceless national asset.

With respect to the applications through which space science and technology can begin to yield useful benefits, public policy has been established to bring into being as quickly as possible a worldwide operational system for communications based on relay satellites.

In this field, three important research and development projects have been instituted. These are Project Relay, being developed for NASA by the Radio Corporation of America; the TSX satellite program through which the American Telephone and Telegraph Company is applying its own resources at its own expense to contribute to an early national operational capability; and the Syncom utilizing the resources of the Hughes Aircraft Company.

All these projects are being carried out in the closest association with the Federal Communications Commission and

other interested government departments as well as with the organizations and interests in other nations concerned in international communications. The principle of privately regulated operation by a grouping of the present carriers has been endorsed, and a strong effort is being made to implement it. However, complete reservation of foreseeable governmental interest has been made. Governmental needs include those relating to international cooperation, worldwide availability of service, and such military needs as can be fulfilled through the use of common carriers.

Arrangements have been made to keep a TIROS weather satellite in orbit at all times until a follow-on system operated by the United States Weather Bureau and based on the Nimbus satellite is brought into being.

Congress has now appropriated funds for this, and the Weather Bureau will this year initiate the first steps toward the Nimbus worldwide meteorological network. Meanwhile, an international conference of all nations interested in participating in this new worldwide weather satellite system has been called and will be held within the next few weeks.

The United States Navy has made a large step forward in the applications field through the successful launching of the Transit navigational satellite. Arrangements are now being considered to utilize Transit capabilities to meet the navigational requirements of commercial airplanes and ships.

I hope this explanation of some of the actions we have taken will serve to make the program more meaningful. I believe that these actions also demonstrate that, in such matters, we Americans are a pragmatic people. We have always adopted new measures to meet new conditions. In the post-war period, major milestones were passed with the adoption of the Marshall Plan, the North Atlantic Treaty Organization, the Berlin airlift, support of the United Nations action in Korea, the landing of troops in Lebanon, and others that you can recall. Now that we are faced with another national requirement that will commit us for many years to a major undertaking, we are well aware that second best is not good enough.

Most Americans are beginning to understand that the rocket is the first instrument available to us that can

provide great thrust in the atmosphere and also in the reaches of space. There is a spreading understanding that it is this rocket-based ability to fly experimental equipment beyond the earth's atmosphere that now opens to scientists a vast new step toward examining the forces of nature and particularly the relationships between the earth and the sun. Ways of means of extending man's knowledge of astronomy, electromagnetic waves, nuclear reactions, plasma physics, gas dynamics, relativity, gravity, and many other areas are being more and more discussed in inter-disciplinary meetings on university campuses and are spreading out from there for broader general public understanding. At least some of the public is catching up with Editor Bloomfield's elite.

To the pragmatic American, proof that man can survive in the hostile realm of space is not enough. A solid foundation for public support and the basis for our Apollo man-in-space effort is that U.S. astronauts are going into space to do useful work in the cause of all their fellow men. If the conditions required for useful work in space are formidable, so are the tasks of stretching technology to meet them.

When I first went over to the State Department in 1949, Bob Lovett, my predecessor as Under Secretary, cheered me up considerably when he told me that trying to effect a re-organization would be like attempting to take out the appendix of a man carrying a heavy trunk up three flights of stairs.

The organization problems of the new program in the Space Administration have been no less acute. However, in the past eight months -- based largely on the splendid organizational work and careful studies made by the first NASA Administrator, Dr. Keith Glennan -- we have established a pattern that is, at one and the same time, practical and flexible. It takes account of the best abilities of our senior people, establishes strong leadership in our research and operational centers, makes authority and responsibility run together, and provides for sensitive but effective command and control of the resources required in our space program.

We have divided our work into four major program categories: 1) advanced research and technology in aeronautics

and space; 2) scientific study of the space environment and celestial bodies, through all available disciplines, and by instrumented unmanned satellites and space probes; 3) application of earth satellites to such immediate uses as weather observation, global communication and navigation; and 4) exploration of space by man.

Each of the four NASA Program Directors, within his particular program area, has over-all responsibility for projects, establishes technical guidelines, budgets and programs funds, schedules each project, and evaluates and reports progress.

The Directors of NASA's research and development centers report directly to the Associate Administrator who serves as general manager. In this way, they have an increased voice in policy making and program decisions.

Looking back at highlights of the past eight months, there was the work involved in evaluating the resources and requirements, integrating our efforts with those of the Department of Defense and other government agencies, working with Director of the Budget, the Vice President and Space Council, and the President, himself, to determine the total range of Executive Branch requirements. There were the approximately thirty appearances before Congressional bodies to justify the President's recommendations; there were the innovations required in the communications satellite field to carry on the research and development to meet governmental requirements and at the same time bring into play, in a manner consistent with the public interest, the very large resources of the principal potential user of any foreseeable system (the American Telephone and Telegraph Company).

These efforts resulted in a virtual doubling of the program and in laying a foundation under which it will again almost double in 1963. What these busy months add up to, I think, is a national space effort characterized by initiative on the part of many able men and responsibility on the part of those who had to make the governmental decisions, all in the best tradition of American democracy.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1200 K STREET, NORTHWEST • WASHINGTON 25, D. C.
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FOR RELEASE: October 16, 1961

RELEASE NO. 61-230

INTERNATIONAL SATELLITE & SPACE PROGRAM SURVEY

The following space vehicles are in orbit as of this date:

<u>NAME/COUNTRY</u>	<u>LAUNCH DATE</u>	<u>TRANSMITTING</u>
Explorer I (US)	Jan. 31, 1958	No
Vanguard I (US)	Mar. 17, 1958	Yes
*Lunik I (USSR)	Jan. 2, 1959	No
Vanguard II (US)	Feb. 17, 1959	No
*Pioneer IV (US)	Mar. 3, 1959	No
Explorer VI (US)	Aug. 7, 1959	No
Vanguard III (US)	Sept. 18, 1959	No
Explorer VII (US)	Oct. 13, 1959	Yes
*Pioneer V (US)	Mar. 11, 1960	No
Tiros I (US)	Apr. 1, 1960	Yes
Transit I-B (US)	Apr. 13, 1960	No
Spacecraft I (USSR)	May 15, 1960	No
Midas II (US)	May 24, 1960	No
Transit II-A (US)	June 22, 1960	Yes
NRL Satellite (US)	June 22, 1960	No
Echo I (US)	Aug. 12, 1960	No
Courier I-B (US)	Oct. 4, 1960	Yes
Explorer VIII (US)	Nov. 3, 1960	No
Tiros II (US)	Nov. 23, 1960	Yes
Samos II (US)	Jan. 31, 1961	No
*Venus Probe (USSR)	Feb. 12, 1961	No
Explorer IX (US)	Feb. 16, 1961	No
Discoverer XX (US)	Feb. 17, 1961	No
Discoverer XXI (US)	Feb. 18, 1961	No
Explorer X (US)	Mar. 25, 1961	No
Discoverer XXIII (US)	Apr. 8, 1961	No
Explorer XI (US)	Apr. 27, 1961	Yes
Transit IV-A (US)	June 29, 1961	Yes
Injun-SR-3 (US)	June 29, 1961	Yes
Discoverer XXVI (US)	July 7, 1961	No
Tiros III (US)	July 12, 1961	Yes
Midas III (US)	July 12, 1961	Not Available
Explorer XII (US)	Aug. 5, 1961	Yes
Discoverer XXX (US)	Sept. 12, 1961	No
Discoverer XXXI (US)	Sept. 17, 1961	No
Discoverer XXXII (US)	Oct. 13, 1961	Yes

*In solar orbit; others in Earth orbit.

CURRENT SUMMARY (October 16, 1961)

Earth Orbit: US - 31
USSR - 1

Solar Orbit: US - 2
USSR - 2

Transmitting: US - 12
USSR - 0

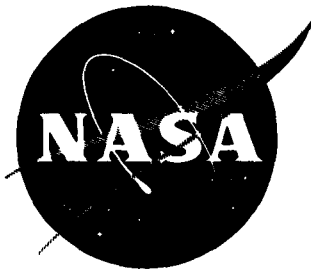
COMPLETE SUMMARY (Launched
to date)

Earth Orbit: US - 53
USSR - 13*

Solar Orbit: US - 2
USSR - 2

Lunar Impact: USSR - 1

*Lunik III passed once around
Moon, then into Earth orbit.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
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FOR RELEASE: Tuesday AM's
October 24, 1961

Release No. 61-231

NASA FUNDS STUDIES OF "UNCONVENTIONAL" ROCKETS

A program to investigate new techniques of building large liquid rocket engines is being sponsored by the National Aeronautics and Space Administration.

The purpose of the two parallel efforts is to determine whether there is an "unconventional" engine and vehicle design concept for a rocket stage of two million pounds or more that can be developed and produced at significant savings, simultaneously assuring increased reliability.

The ten-month contracts are being carried out by Aerojet-General Corporation and Rocketdyne Division of North American Aviation at a cost of about \$185,000.

The thrust range of the units under consideration is from two to 24 million pounds.

Determination of the engine concept is the primary goal of the work, although it is necessary that combined engine-vehicle configurations be explored to evaluate fully the advantage of various engine concepts.

Propellants for the investigations are liquid oxygen/hydrocarbons and liquid oxygen/liquid hydrogen. If a design concept superior to the conventional is found, a second objective is to establish design criteria and geometry for the engine.

The work is part of the NASA Advanced Technology Program for Liquid Rocket Engines.

- End -

Address by

Robert C. Seamans, Jr., Associate Administrator
National Aeronautics and Space Administration

before the

Sixteenth Engineering Conference
of the
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THE ROLE OF INDUSTRY IN SPACE EXPLORATION

I am very happy to have this opportunity to discuss our National Space Program with you this evening. This is a program recommended by President Kennedy and approved in the last session of Congress. Its implementation involves not one, but several, government agencies -- including the Department of Defense, the Atomic Energy Commission, the Department of Commerce, and the National Aeronautics and Space Administration. Universities will support the basic research activity and will supply the program with increasing numbers of qualified scientists and engineers. American industry will design and fabricate the boosters, space vehicles, launch facilities, and worldwide tracking stations for the many different types of space missions.

This program is truly a national effort. In his May 25 State of the Union Message, President Kennedy said:

"Now is the time to act, to take longer strides -- time for a great new American enterprise -- time for this nation to take a clearly leading role in space achievement . . . I believe that the nation should commit itself to achieving the goal, before the decade is out, of landing a man on the moon and returning him safely to earth."

Four major reasons underlie the national decision to marshal the resources required for leadership in space: 1) the quest for scientific knowledge; 2) direct and immediate application of satellites into operational systems; 3) the technological advances and stimulus to our economy that will emerge from the space effort; and 4) the risk of delay in our space competition with Communism.

Scientific Knowledge

Two problems provide particularly important examples of the unique contributions which space flight vehicles can make to the solution of fundamental scientific problems, and of the reasons for the great interest of the scientific community in this area.

The first of these problems is the origin and history of the solar system.

We know that the solar system was formed about 4.5 billion years ago, but we do not know how it was formed. This problem has been the

subject of much thought and speculation for centuries. The investigation of the origin of the solar system by instruments carried to the moon and planets in spacecraft is a project of the greatest scientific importance and general interest.

The moon will play a special role in this investigation because it is a body whose surface has preserved the record of its history for a much longer period than the earth, and probably much longer than Mars and Venus as well. On the earth, the atmosphere and the oceans wear away surface features in 10 to 50 million years. Mountain-building activity turns over large areas of the surface in about the same time. There is little left on the surface of the earth of the features that existed several hundred million years ago. The same is probably true of Mars and Venus. But on the moon there exist no oceans and very little atmosphere to wear away the surface. Also, telescopic inspection of the moon's surface reveals few signs of the mountain-building activity which distorts and replaces the surface of the earth so rapidly.

Thus the moon's surface will carry us back very far into the early history of the solar system, perhaps not back to the birth of the sun and planets, but certainly billions of years into the past -- much longer than the 10 to 20 million years during which surface events, still decipherable today, transpired on earth.

Not only the lunar surface, but also the internal structure of the moon may provide a clue to the early history of the solar system and to the birth of the planets.

One theory about the creation of the planets -- widely held until recently -- was that the solar system had been created during a near collision between our sun and another star, in which the gravitational forces between these two massive bodies tore huge streams of flaming gas out of each. As the intruding star receded, the masses of gas which happened to be near the sun were captured by it into orbits in which they eventually cooled and solidified to form the planets. If such a collision was the manner of formation of the solar system, then the moon and planets must have been molten at an earlier stage in their histories. In that event, the iron in their interiors would melt and run to the center to form a dense core.

Another theory holds that the planets were formed out of pockets of condensation in the dust surrounding our sun during the early stages of its lifetime. We know that stars themselves are almost certainly formed in this way, by condensation of pockets of interstellar gas and dust which happened to be somewhat denser than their surroundings. It seems likely that additional subcondensations could have developed in the tenuous matter surrounding the sun before the central condensation had proceeded to its final stages; and that the moon and planets were eventually formed from these subcondensations.

Large bodies such as the earth have enough radioactive uranium inside them to produce melting of iron simply through the heat generated by nuclear activities. Therefore, the existence of a dense core of iron in the interior of the earth does not prove the validity of the collision theory, nor disprove the condensation theory. However, the moon is smaller and colder, and will provide a much better indication than the earth, as to which of the two theories on the origin of the solar system is correct.

The first major project in our program of lunar and planetary exploration will carry payloads containing instruments designed specifically to obtain information on the internal structure of the moon. This is the Ranger series of spacecraft, which will contain gamma ray detectors for measuring the level of radioactivity in the lunar surface, as the spacecraft approaches the moon. The Ranger spacecraft will also contain a seismometer, or earthquake measuring instrument, which will be detached from the main body of the propulsion unit at some distance above the moon's surface, and slowed down by the firing of retrorockets as it approaches the surface so that it can land with a jolt that is not too heavy to permit it to function after impact. Attached to the seismometer will be a radio beacon designed to transmit back to earth the data received by the seismometer on the level of earthquake or "moonquake," activity and thus on the internal structure of the moon. Analysis of such

seismometer records made on earth has yielded most of our information regarding the internal structure of the planet on which we live.

This same Ranger spacecraft will also contain a TV system designed to transmit images of the moon's surface features to the earth stations with a degree of detail many times greater than we can obtain from our best surface-based telescopes.

A second problem of great importance in the space science program is study of the control exerted by the sun over events on the earth.

Most energy emitted by the sun falls in the visible region of the spectrum and is transmitted to the ground and to the lower atmosphere, where a part is absorbed and a part is radiated back into space. Variations in absorption of visible light produce an uneven heating of the lower atmosphere, leading to winds and other weather activity. Predicting the response of the atmosphere to this local heating is the basic problem of meteorology.

The visible light which produces the heating does not vary appreciably with time, as far as we know. However, one very small part of the sun's energy output does undergo violent fluctuations. This part comprises the gusts of X-rays, ultraviolet light, and charged particles emitted from the sun at times when its surface is unusually turbulent. We know that the surface of the sun boils and bubbles in an active manner, and sometimes ejects such clouds of charged particles and streams of radiation into the space between the sun and the planets.

These solar eruptions are known as flares. Their appearance marks what may be called a storm on the surface of the sun. By analogy with the earth we refer to flare activity as solar "weather."

When a flare is situated in the right position on the sun's surface, the clouds of charged particles are ejected in such a direction that they reach the earth and interact with its atmosphere. These particles produce communications blackouts and disturbances, magnetic storms, and auroral displays. The entire matter of sun-earth relations constitutes a relatively new area of research in each of the sciences. It is an area which provides at the moment perhaps the most exciting and fruitful opportunity for research in the space science program.

Direct and Immediate Applications

What we are learning in space will affect the lives of every one of us, from farmers, industrial workers, housewives, and school children to doctors and business executives. Seasonal and outdoor industries will benefit greatly. For example, this new technology will soon provide the basis for meteorological and communications satellite systems.

The use of satellites to gather meteorological information promises greatly to improve weather forecasting and thus to return large dividends to the economy. Today only one-fifth of the globe is covered by ground-based weather reporting systems. NASA is developing the TIROS series of weather satellites to provide worldwide observation of atmospheric elements -- the data meteorologists must have to understand atmospheric processes and to predict the weather.

TIROS I, shaped like a hatbox, was launched April 1, 1960. Its main sensors were two TV camera systems. Tape recorders made it possible to store pictures taken over areas distant from the U. S. and to read them out as the satellite passed over this country. The highly successful 270-pound satellite, orbiting at altitudes averaging 450 miles, transmitted 22,952 television pictures of the earth's cloud patterns.

Within 60 hours after the first TIROS was in orbit, its reports were being applied to day-to-day weather forecasting. In Hawaii, TIROS pictures helped trace tropical storms. Data on storms in the Indian Ocean were used by Australian meteorologists.

NASA is receiving excellent cloud pictures and infrared data from TIROS III, launched July 12, 1961. Orbiting to coincide with the hurricane season, the satellite has been gathering information on the origin, development, and movement of these massive tropical storms. The Weather Bureau has employed TIROS III pictures to help analyze and track Storm Eliza in the Pacific and Hurricanes Carla and Esther in the Gulf and the Atlantic. In fact, TIROS III spotted Esther two days before this giant wind was observed from aircraft.

Japanese weathermen have made good use of TIROS III data supplied by the U. S. Weather Bureau. According to the chief of Japan's weather bureau, the information was valuable in plotting tropical storms. He states that weather satellites would open a new era in forecasting typhoons, from which Japan has suffered so heavily in the past.

NASA used TIROS III for weather support of Astronaut Grissom's July 21 Mercury suborbital flight. Twice a day as the satellite passed over the Caribbean, one of its two TV cameras was triggered to report weather conditions in the area of the flight.

After the TIROS series will come the Nimbus satellites. The first of this family of advanced NASA weather satellites is due to be launched about mid-1962. Its cameras and other atmospheric sensors will always face the earth, and its polar orbit will enable it to view every area on earth twice a day.

This means that a global system of accurate, long-range and short-range weather prediction is in the offing. We might some day even have one-month forecasts or predictions for an entire season.

With a long-range prediction of rainfall or drought, communities could prepare for control of their watersheds. From satellite observations will come early warnings of tornadoes, floods, hurricanes and other catastrophic events, enabling people to strengthen levees, take shelter, and prepare for disaster relief. Weather-sensitive industries would gain enormously by improved weather services that satellites can make possible.

Many in this audience have, from time to time, sighted NASA's Echo I passive communications satellite, launched in 1960. It has been seen, like a bright moving star, by people in most countries. The

huge, aluminized plastic sphere proved that it is possible to transmit telephone and other electronic messages at transoceanic distances by reflecting radio signals from a satellite orbiting the earth.

Great interest has been shown by private firms in both the Echo concept, and in "repeater" satellites that can receive messages at one point over the earth's surface, store them on tape, and later retransmit them to ground receiving stations.

First, there is Project Relay, for which the Radio Corporation of America is designing and constructing a communications satellite to be launched in 1962. Relay satellites will have a low orbit and will be used to demonstrate intercontinental television. The satellite will be able to receive and retransmit telegraph and telephone messages as well as television signals.

The second project is a cooperative NASA agreement with the American Telephone and Telegraph Company. Two or more active satellites will be built by A.T.&T. at its own expense. They will be launched by NASA, with A.T.&T. paying the costs.

NASA also has a contract with the Hughes Aircraft Corporation to acquire a very lightweight satellite called SYNCOM, which will be flown in a so-called 24-hour synchronous orbit. A satellite placed in an equatorial orbit at the height of 22,300 miles, with the right velocity, will appear synchronous or stationary over a fixed point on the earth. SYNCOM will be launched late next year as another experimental relay link for telephone and telegraph messages.

One expert in the communications industry states that a single satellite, costing about \$40,000,000 and placed in a 22,300-mile orbit, could accommodate as much traffic as a \$500,000,000 cable system. Dr. Lloyd V. Berkner, chairman of the Space Science Board of the National Academy of Sciences, recently estimated that use of satellites could increase present global communications capacities some 10,000 times and that tax revenue from such a system could largely defray the expenses of the entire space program.

The entire communications industry is convinced that such communication satellites present an enormous potential for increasing our long-distance communications resources. In the telephone and telegraph areas alone, there appears to be unanimity in the industry that satellite communications will provide a more economical means than new submarine cables for meeting the greatly increased demands for transoceanic services which can be anticipated during the coming decade. For the first time, worldwide television becomes foreseeable; and entirely new forms of global communications, such as closed-circuit TV on an international basis, are made possible.

Technological Advances and Stimulus to Our Economy

The future toward which we are moving so rapidly may seem fantastic, even disturbing, to some of us. Nothing is truer, however, than this -- if we do not grow, we stagnate. Benefits derived from space technology promise far more to our society than the most optimistic economists could have speculated five years ago.

History abounds with examples of the manner in which man's striving toward difficult technical goals has brought on vast, unforeseeable consequences. One of the best known and most dramatic examples was the attempt to apply primitive steam power to pump mines and to operate textile machinery in England. This brought about the industrial revolution with all its social, political, and economic consequences because it spurred research in such fields as materials, metallurgy, thermodynamics, chemistry, and physics. The research, in turn, provided information necessary to construct even better machines and engines to power them.

Crude as the beginnings were, they led to modern mills and factories, to railroads, steamships, automobiles, and aircraft. Two aspects of such major advances are characteristic.

First, the practical results are largely unforeseeable, primarily because they develop on broad fronts and, frequently, in unsuspected directions. Second, the concentration of effort required does not diminish effort expended on other frontiers of knowledge, but rather spurs such activities. For example, despite fears that space technology would

monopolize the scientific effort of this country, such fields of activity as oceanography, geophysics, and the physics of high-energy particles have greatly increased since the national space effort has become a serious one.

The technology we are developing in these programs will be of immense and growing benefit to the economy. Into consumer goods are going new techniques, materials, alloys, plastics, fabrics, and compounds of many kinds, originally created to do space jobs. Some 5,000 firms are now engaged in various phases of work supporting the space effort.

A key requirement for all spacecraft is compact electrical energy sources that will operate reliably over long periods. At present the United States is using and developing sun-powered batteries, fuel cells, light-weight atomic reactors, and other devices to generate electricity for sensing instruments and radio equipment in satellites and probes.

One such nuclear reactor, although still in an experimental stage, offers a good preview of what we may expect from space-developed power sources. Weighing only 200 pounds, it generates as much electricity as could be supplied by 500,000 pounds of ordinary chemical storage batteries.

On earth, such power sources can be used wherever unattended sources of power are required, such as in remote weather stations, radio beacons, navigation links, communications stations, and for portable power plants that could be transported by truck for use in emergencies.

This is only one example of how by-products of space research and development are, and will increasingly be, affecting life on earth. The list could be extended almost indefinitely.

History has repeatedly proven that increases in technical capability have never gone unused. The capability of doing new things has always resulted in its being found profitable to use this capability to profitable advantage.

For example, the first crude motors of the "horseless carriage" led to the automobile which brought about in one lifetime tremendous changes, not only in transportation but in almost every aspect of our lives. Yet few people saw the early automobile as the first phase of a vast technological revolution. It was the object of popular derision and was even attacked by some doctors as "a worse health menace than alcohol or nicotine."

Risk of Delay

Vice President Lyndon Johnson said in an address to the American Rocket Society in New York last week, "We are developing peaceful uses of outer space from choice, but we are working on military uses of outer space from necessity."

It is not my place to discuss military missions. However, there is an important interchange of components and vehicles between our military and non-military programs. United States mastery of space is essential insurance against finding ourselves with a technology inferior to that the Russians will develop as they press forward on the space frontier.

If we allow them to surpass us, their space technology in its military aspects will be used to jeopardize our security.

In addition to potential direct military conflicts, the Free Societies are in deadly competition with the Soviets for the support of the uncommitted peoples of the world. Space activity has great emotional appeal and we cannot afford the risk of being passed or appearing to be passed.

Today, prestige is one of the most important elements of international relations. Essential is the belief of other nations that we have capability and determination to carry out whatever we declare seriously that we intend to do. There is no denying that in the eyes of the world during the past few years our capability and determination have been brought into serious question.

In the minds of millions, dramatic space achievements have become today's symbol of tomorrow's scientific and technical supremacy. There is, without a doubt, a tendency to equate space and the future. Therefore, space is one of the fronts upon which President Kennedy and his Administration have chosen to act broadly, vigorously, and with continuous purpose. No other single field offers us the opportunity to gain more of what we need abroad and at the same time to achieve such a wealth of both practical and scientific results at home.

Unmanned Space Flight

Since January 31, 1958, this country has successfully launched 52 earth satellites, two solar satellites, and two deep space probes. The most recent is Explorer XII which is making simultaneous measurements of many aspects of the space environment between altitudes of about 200 and 50,000 miles from the earth.

Among our most successful experiments to date have been the Pioneer series of space probes. Pioneer V, for example -- launched into solar orbit on March 11 of last year -- was tracked into space to a distance of 22.5 million miles, still the greatest distance any man-made object has been tracked. Pioneer V sent back scientific data on conditions in space until communication contact was lost on June 26, 1960. This space probe gave us new and valuable information about cosmic rays, the earth's magnetic field, solar "storms," and evidence of the existence of a large "ring current" circulating around the earth at altitudes of about 30,000 to 60,000 miles.

Advanced launch vehicles are becoming available for both scientific missions and operational systems. They will have greatly improved load-carrying capability for unmanned space experiments. For example, detailed plans have been made and work has begun on an Orbiting Geophysical Observatory, based on the use of the Agena. This observatory will be one of our first standardized satellites, with a stock-model structure, basic power

supply, attitude control, telemetry, and a command system. Its modular compartments are capable of carrying fifty different geophysical experiments on a single mission. The observatory itself will be about six feet long by three feet square, and will weigh about 1,000 pounds. The two solar "paddles" which collect energy from the sun will be about six feet square.

NASA's plans for extending unmanned space exploration to the moon and beyond are maturing.

I have already mentioned the importance of the Ranger spacecraft in our lunar program. The first Ranger spacecraft was launched on August 23, and we expect to obtain our first information from the lunar surface early next year.

Following Ranger will come Surveyor, a spacecraft that will be able to make a so-called "soft landing" on the moon. More delicate scientific instruments than those in Ranger can thus be employed. Surveyor will have aboard scientific instruments, including drills and tapes to analyze the lunar surface and to determine its make-up. At the same time, high resolution television cameras will transmit to earth pictures of the lunar terrain, both before and after landing takes place.

Also under way is a spacecraft that will fly close to Venus and Mars, and later perhaps other, more distant, planets. This spacecraft, called Mariner, will carry instruments to measure planetary atmosphere, surface temperatures, rotation rates, magnetic fields, and surrounding radiation regions.

Manned Spaceflight

Frequently I have been asked why we are preparing to send men on hazardous spaceflights when instrumented satellites and probes have proven so versatile and have returned such quantities of information on the near-space environment of the earth and on conditions in the vast reaches of deep space.

First, integration of a human pilot into an onboard spacecraft system greatly improves reliability. The man cannot only make inflight tests but also inflight repairs. We have striking examples of this in missions of NASA's X-15 rocket airplane which has been flying to the fringes of space and has achieved a speed of 3,600 miles per hour. In at least eight out of thirty-eight X-15 flights to date, flights would have failed without a pilot in the cockpit to correct malfunctions of equipment, instruments, or powerplant. In at least as many other cases, if X-15 missions had been unmanned, we would have obtained no information because either instruments or telemetry failed. The X-15 pilot, however, was able to land with valuable flight information recorded by his own senses.

Second, while instruments can perform many tasks of sensing and measuring better than men, the statistical information gathered and transmitted to earth by these devices constitutes only a part of the basic research necessary for understanding the larger realities of

space. The most advanced apparatus can perform only as it is programmed to do. Instruments have no flexibility to meet unforeseen situations. Scientific data acquired in space mechanically must be balanced by on-the-spot human senses, human reasoning, and by the power of judgment compounded of these human elements.

At present, the National Aeronautics and Space Administration has two manned spaceflight programs, Project Mercury and Project Apollo.

Project Mercury is designed to put a manned satellite in orbit at an altitude of more than 100 miles, circle the earth three times, and then bring it back safely. As you know, two manned suborbital flights carrying Astronauts Alan Shepard and Virgil Grissom have already been made. The first manned orbital flight is planned for late this year or early in 1962.

Project Mercury was designed to tell us how man will react to spaceflight, how he can perform in a space environment, and what should be provided in future manned spacecraft to allow him to function usefully. Equally important, of course, is the technical knowledge which Project Mercury will give us about the design, construction, and operation of the first U. S. vehicle specifically engineered for manned spaceflight.

The flights of Astronauts Shepard and Grissom were intensely interesting, although of short duration, each about 15 minutes. During these 15 minutes both Shepard and Grissom carried out in the spacecraft

the tasks that were assigned to them, including attitude control and correction and deceleration rocket firing. Each was subjected to about five minutes of weightlessness and found this no handicap in performing his duties. Each endured, without harmful results, gravity forces six times his own weight due to the accelerations of rocket launch, and eleven times his own weight due to entry decelerations.. Both were in constant voice communication with the ground. The physiological reactions of both men before, during, and after the flight, did not materially differ from reactions shown during earlier ground tests.

The second step in the NASA manned space program is Project Apollo, designed to lead ultimately to a three-man expedition to the moon. Apollo will require space techniques far in advance of those needed for Mercury. Apollo must be built to withstand a much greater launch thrust. It must be capable of guidance toward the moon and it must be able to land gently on the moon, then be launched from the moon and guided back for safe return into the earth's atmosphere at the fantastic speed of 25,000 miles per hour.

Like other achievements in space, the Apollo flights must be a step-by-step process. The spacecraft will first be flown in orbit around the earth so that the many components and systems of the vehicle can be tested and evaluated.

These earth-orbiting flights will also be used for training the space crew and for development of operational techniques. Each will also include important scientific experiments.

As the competence of the Apollo vehicle and the men who will operate it increases, the flights will go farther and farther from earth, and will be of longer duration and complexity. A major step will be a manned flight around the moon, on which the crew will perform many of the guidance and control tasks that will be needed later on in the lunar landing mission.

The launch vehicle for Apollo's earth orbit and circumlunar flights will be Saturn. The cluster of eight engines in the first stage will provide $1\frac{1}{2}$ million pounds of thrust for more than two minutes compared with the 360,000 pounds of thrust provided by the Atlas booster for Mercury flights. The Saturn first stage is currently fabricated at our George C. Marshall Space Flight Center in Huntsville, Alabama, and is carried on a barge from there on the Tennessee, Ohio, and Mississippi Rivers to the Gulf of Mexico and thence to the Atlantic Ocean and Cape Canaveral. We have recently acquired a 47-acre air-conditioned plant in New Orleans for the manufacture of this and other large stages on contract. This location will minimize the time required for transportation and consequently will permit a more efficient operation.

A giant clustered booster called Nova--which will develop 12 million or more pounds of thrust--is required for the lunar landing flight by direct ascent. Another possible approach involves the use of an advanced version of the Saturn with assembly of the lunar vehicle in orbit by rendezvous techniques. We are conducting analytical studies and technological developments in support of both possibilities.

Space Exploration -- A National Program

As I have already indicated, NASA, other government agencies, universities, and industry all have important responsibilities in the conduct of this rapidly expanding effort.

For Fiscal Year 1962, the National Aeronautics and Space Administration has budget of \$1,671,750,000. This includes \$245,000,000 for construction of new and supporting facilities and \$1,220,000,000 for research and development. We feel that the NASA staff should be kept at a level necessary to plan the space exploration program and to organize, contract for and oversee it, while conducting enough in-house work to maintain the calibre of our scientific and technical personnel. We currently have about 18,000 employees located in our Washington Headquarters and eight research and flight centers. However, eighty-five percent of the NASA research and development budget is spent through contracts with industry and private organizations.

The 1962 program is approximately twice the size of the 1961 program. Funding requirements will increase still further in 1963 if we are to meet the goals recommended by President Kennedy.

The large sums of money required in this effort are not spent in space or on the moon. They are spent in the nation's factories, workshops, and laboratories for salaries, materials, and supplies.

The investment in space progress is big and will grow, but the potential returns on the investment are even larger. And because it concerns us all, scientific progress is everyone's responsibility. Every good citizen should understand what the space program really is about and what it can do.

Space presents us with a challenge ideally suited to stimulate a wealth of new advances across most of the technical-industrial spectrum. Ultimately, all men must gain from space exploration. If, however, one nation pursues space diligently while others do not, that nation will find itself in a dominant technological role such as England enjoyed for more than a century. If that nation is one which does not have a heritage of freedom and political liberty, mankind may have a somber experience that could last a very long time.

This is the heavy space age responsibility we bear: to assure that the United States maintains scientific and technological leadership, now and in the future.

In conclusion, I would like to quote Senator Robert Kerr, of Oklahoma, who is Chairman of the Senate Committee on Aeronautical and Space Sciences. Recently he said, "I am convinced that the nation which leads in exploring and using space for peaceful purposes can best build, improve, and inherit the earth."

I firmly believe that history will bear out Senator Kerr's statement.

October 19, 1961

1:38 EDT

WALLOPS ISLAND, Va. -- A four stage solid propellant Scout rocket boosting a 94-lb. payload was launched at 1:38 EDT today from the NASA's Wallops Island, Va. The probe is expected to go some 4500 miles above the earth to explore the physical phenomena in the upper ionosphere, a little understood region which exerts a profound influence on life on earth.

The experiment is being conducted by the Goddard Space Flight Center, Greenbelt, Md.

1:55 EDT

WALLOPS ISLAND, Va. -- Fourth stage ignition on Scout 7 launched today cannot be confirmed at this time.

Antennas on the probe did deploy and telemetry is being received from the payload.

3:30 EDT

WASHINGTON -- All four stages of the Scout launch vehicle carrying the P-21 electron density profile probe have fired successfully, the NASA announced. The probe followed its programmed flight program.

Robert Bordeaux, head of the Planetary Ionospheres Branch of the Goddard Space Flight Center which instrumented the payload said it appears "we got good data all the way."

There was a slight delay in confirming that the fourth stage of the rocket had ignited to give scientists an opportunity to thoroughly study the flight records.

The probe reached an altitude of about 4261 statute miles and impacted in the Atlantic Ocean about 4424 statute miles from Wallops. Flight time was approximately 90 minutes.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: AM's Sunday
October 22, 1961

Release No. 61-232

DR. COX TO JOIN NASA

James E. Webb, Administrator of the National Aeronautics and Space Administration, today announced the appointment of Dr. Hiden T. Cox as Assistant Administrator for Public Affairs.

Dr. Cox, granted a leave of absence as Executive Director of the American Institute of Biological Sciences (AIBS), will assume his special assignment December 1. As Assistant Administrator for Public Affairs, he will report directly to the NASA Administrator.

Mr. Webb said Dr. Cox would be responsible for directing and coordinating policies and activities concerning dissemination of general and technical information, educational programs and relations with other governmental agencies, universities and industrial research organizations.

Dr. Cox was born at Greenville, S. C. on March 3, 1917. He was educated in Greenville schools and received B.S. and B.A. degrees from Furman University, Greenville, and M.A. and Ph.D. degrees in botany from the University of North Carolina.

He served on the faculties of Howard College and Agnes Scott College before going to Virginia Polytechnic Institute as professor of biology. In 1955, he was named director of AIBS.

He is a member of many scientific and professional organizations, including: member, Board of Directors of the National Society for Medical Research; fellow of the American Association for the Advancement of Science, and member, Council of AAAS; member of the Governing Board, Division of Biology and Agriculture of the National Academy of Sciences--National Research Council.

Dr. Cox is married to the former Elizabeth Vera Rannow of New York City. He, his wife and daughter, Betty Anne, 4, live at 1411 Stonebrae Drive, Falls Church, Va.

-End-



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: Upon delivery - Oct. 21, 1961

RELEASE NO. 61-233

The National Significance of the Augmented Program of Space Exploration

Hugh L. Dryden
Deputy Administrator
National Aeronautics and Space Administration

(Speech before The Commercial Club of Cincinnati,
at the Natural History Museum, Cincinnati, Ohio,
October 21, 1961)

During the past 60 years our Western society has been dominated by the influence of major developments in science and technology. This period has been marked by the emergency in rapid succession of new fields of engineering and new industries. We passed rapidly from the automotive age to the air age, to the nuclear age, and now to the age of space exploration.

Each of these scientific and technological developments has had a profound impact on every aspect of human affairs. Each provided in essence a mere change in man's physical environment and in the tools which he had at his disposal, but each produced many other changes in his way of life. There were important and direct effects on the economic development of the nation, including the application of the new techniques developed to other branches of industry. There were important contributions to national defense through the application of the new knowledge to military devices. There were major influences on the education of our children and on nearly every aspect of our political and social life. Scientific and technological developments played an increasing role in international affairs. Finally there were important repercussions on human thought and aspirations. Intellectual and spiritual horizons were expanded. Similar widespread effects are to be expected from the development of space science and technology and their application to the exploration of space.

Astronomers remind us that the exploration of space began centuries ago when man began to study the skies. Through the centuries a tremendous amount of information has been obtained by suitable analysis of the light from the stars and celestial bodies which penetrates the earth's atmosphere. However, the recent development of large rockets for military purposes has brought to man the means of sending instruments far out into space for direct measurement, and of venturing himself for short distances to explore and to discover and to learn. Thus we now date the age of space exploration from the launching of the first man-made satellite of the earth on October 4, 1957. In four years man has sent some 65 such artificial moons into orbit around the earth and four in orbit about the sun. The total weight of these objects is more than 75 tons, not much compared with the weight of the moon, but an impressive beginning.

Immediately after the launching of the first Sputnik the United States began the consideration of its role in the exploration of space. During the several months of deliberation by the Executive and Legislative branches of the Government responsibility for formulating an immediate program was temporarily assigned to the Department of Defense.

The National Aeronautics and Space Act was passed by the Congress on July 29, 1958. The Congress declared that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind, and set up a civilian agency to implement this policy. Activities in space associated with the development of weapons systems, military operations, or the defense of the United States were reserved to the Department of Defense. Among the objectives set up by the Act were cooperation with other nations in aeronautical and space activities and in peaceful application of the results, and the widest practicable and appropriate dissemination of information concerning the activities of the new agency and the results obtained.

Immediately following the passage of the National Aeronautics and Space Act of 1958 a substantial space program was initiated and aggressively pursued.

From the beginning the U.S. space program has had four general objectives. These are (1) to study the space environment by scientific instruments of many types launched into space by sounding rockets, space probes, earth satellites, and artificial planets; (2) to begin the exploration of space and the solar system by man himself; (3) to apply space science and technology to the development of earth satellites for peaceful purposes to promote human welfare; and (4) to apply space science and technology to military purposes for national defense and security.

The major aims of space science are (1) to study the earth and its atmosphere and the influence of the sun upon the earth; (2) to study the nature of the solar system, including the conditions on the sun, moon and planets, and phenomena in interplanetary space; (3) to search for the possible existence of plant or animal life or life-related substances in the solar system; and (4) to contribute to man's understanding of the origin and nature of the universe as a whole.

The program for the exploration of space by man looks forward to a continually increasing capability and accumulation of experience. I will discuss this program a little later.

The principal applications of earth satellites which have made important progress are weather satellites, communications satellites, and navigation satellites. Results from the TIROS research and development satellite have opened new vistas to the forecaster and research scientist alike, and a TIROS will be kept aloft until the more advanced Nimbus satellite comes into use. Many regard the weather satellite as the most important development in the history of weather observation and forecasting. The time is not far distant when a global communication system will serve remote parts of the world with capability for television as well as telegraph and telephone.

Present applications of space science and technology to military purposes are to early warning satellites and military communication satellites. Other applications will follow as the technology develops and the need arises.

In 1959 a ten-year plan was developed, outlining the various flight missions projected during this period and the major developments in launch vehicles and spacecraft to be accomplished in order to fulfill the stated objectives. Under this plan manned orbital flight was to be accomplished in 1961, impact landing of instruments on the moon, advances in planetary spacecraft, and launching of a prototype active communication satellite in 1962. An orbiting astronomical observatory and an unmanned planetary reconnaissance flight was planned for 1964. In 1965 the prototype of a three-man capsule was to be tested for project Apollo, conceived as one element of an earth-orbiting laboratory and also as a basic vehicle for circumnavigation and manned exploration of the moon. Under the original plan the manned lunar landing mission was considered to lie beyond 1970. This plan involved the expenditure of some twenty to twenty-five billion dollars over the ten-year period.

Following the election of President Kennedy an intensive study was made of the policies underlying the then existing ten-year plan. On March 24th of this year President Kennedy submitted a request for an additional \$125,670,000 to speed up the development of large boosters, an area in which we stood at a disadvantage as compared with our competitors in space technology. On May 25th the President in a special message to the Congress on urgent national needs announced major new goals for the nation in space and new programs to achieve them. He stated "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth. No single space project in this period will be more impressive to mankind, or more important for the long range exploration of space; and none will be so difficult or expensive to accomplish. We propose to accelerate development of the appropriate lunar spacecraft. We propose to develop alternate liquid and solid fuel boosters, much larger than any now being developed, until certain which is superior. We propose additional funds for other engine development and for unmanned explorations -- explorations which are particularly important for one purpose which this nation will never overlook: the survival of the man who first makes this daring flight. But in a very real sense, it will not be one man going to the moon -- if we make this judgment affirmatively, it will be an entire nation. For all of us must work to put him there."

To begin the acceleration of the national space program the President requested appropriations for the National Aeronautics and Space Administration amounting to \$1,784,000,000 for fiscal year 1962, but Congress reduced this by about \$112,000,000. Funds were included to accelerate the development of large rocket engines and space vehicles, for speeding up exploration of the environments of the earth and of the moon and the space between, to expedite the Rover nuclear rocket engine, to expedite the development of an active communication satellite system, and to accelerate the development of the technology needed for manned flight to the moon and return to the earth.

The goal of the present project Mercury is to fly a man for three orbits around the earth and to recover him safely. We expect to accomplish this mission late this calendar year or early next year. The follow-on project to accomplish the goal set by the President, i.e., the landing of three men on the moon's surface and the return of these men safely to earth within the coming decade, is called Project Apollo. A preliminary analysis of this project shows more than 2000 tasks that must be accomplished, ranging from the development of new large boosters and the launching facilities necessary to send them into space to experiments on the biological effects of the radiation encountered in space and the study of satisfactory methods of protection, and the engineering development of heat shields for reentry speeds as high as 25,000 miles per hour. Along the road are three major milestones to qualify the capsule and crew for the lunar mission. We are now in the process of evaluating proposals submitted by prospective teams of contractors to design and build the spacecraft that we will eventually use for the lunar landing. We will first launch this capsule into an orbit about the earth in order to check out the equipment under conditions such that, in the event of failure, the crew can be returned safely to earth. When the capsule is satisfactory for this mission we can add to it a rear section which can be used as a space laboratory for investigation of technological and biological problems in the space environment.

We then proceed to launch the spacecraft in elliptic orbits extending out from the earth until finally we send the capsule around the moon and return it to the earth. This circumnavigation of the moon is one of the important milestones. In this mission the capsule can be qualified under the high speed of reentry from the distance of the moon.

We are using a "building block" concept for the several missions. For the final mission to send men to the moon and return it is necessary to add a propulsion section to slow down the capsule for landing on the moon and a second propulsion section for returning the capsule from the moon to the earth.

While the accelerated program is described in terms of the mission of manned exploration of the moon, it is important to realize that the setting of this goal has as its primary purpose a great cooperative national effort to develop space science and technology, which can then be applied to meet both civilian and military objectives. The billions of dollars required in this effort, spent in the laboratories, workshops and factories of the nation, will insure the nation against technological obsolescence in a world of explosive advances in science and technology and against the hazard of military surprise in space. The specific goal set by the President has the highly important role of motivating the scientists and engineers who are engaged in this effort to move forward with urgency, and of integrating their efforts in a way that cannot be accomplished by a disconnected series of research investigations.

The accelerated space program has major significance for the economic development of the nation. Manned exploration of the moon requires the most advanced engineering and technological developments of our time at the very frontiers of knowledge. Major advances are occurring in electronics and communications, new materials, energy sources and energy conversion devices, data collection and handling, computers, knowledge of the behavior of the human body under stress, protective environment for man, and many other areas.

These developments at the frontiers of science and technology are transferable to other applications in industry. Because of the newness of the space age it is difficult to give specific examples at this early date. It is easier to recognize this process in relation to the automotive age, the air age, and the nuclear age. For example, the development of the automobile has brought us the concept of simplification for the operator through complication of design, a concept now widely applied in the operation of a modern

steel mill or oil refinery and in such modern consumer products as automatic washers and ovens, where automatic controls program the entire operation. The automobile is largely responsible for the development of alloy steels, new fuels, synthetic rubber, quick drying finishes, and other new materials.

Similarly the air age brought us great supplies of aluminum and the basis for building light-weight structures, not only for airplanes but also for trains, buses and ships. The nuclear age brought applications of isotopes in medicine and in the inspection of materials. Nuclear developments brought remote manipulators and sealed pumps for hazardous liquids and gases. The space age has brought to maturity the concept of systems analysis and optimization of designs involving many branches of science and engineering. In addition the space age has given us high temperature ceramics, ablating materials for heat protection, pressure stabilized light-weight tanks, computers handling large amounts of data, and many other developments which are finding applications throughout industry.

While the technological developments offer the earliest contributions to economic development, in the long run the contributions from the scientific knowledge obtained in the great unknown environment of the celestial bodies and interplanetary space may bring much greater returns. Today not only the prestige of a nation but also its true greatness and strength depend upon mastery and control of man's physical environment; and the extension and perfection of scientific knowledge is fundamental to that mastery and control. What benefits the new knowledge of the universe may ultimately bring to mankind no one today can predict. Judging from past experience advances in scientific knowledge are the foundation of advances in technology and advances in technology are a key factor in economic development.

The exploration of space has already had significant effect on our educational system. The launching of the first satellite by the USSR brought to a head a movement to reexamine and improve the teaching of science and engineering in colleges and universities which had its roots in the tremendous expansion of military research and development in the birth of the new technologies of nuclear powered rockets and guided missiles. The criticism and examination of the educational system extended to elementary and high school teaching of science, mathematics and English, as well as to the whole content of the curriculum.

The impact of space exploration on education may be summarized as: (1) a demand for the training of more scientists and engineers to meet the needs of the expanding role of science and technology in the modern world; (2) a demand to recognize the presence of various levels of intellectual ability by adapting the content of the curriculum, teaching method, and the rate of progress to the needs of the several groups; (3) a demand for revision of the course material by scientists and educators working in collaboration; (4) a demand for better trained teachers qualified in the subject matter as well as in educational techniques; and (5) the wider teaching of general courses in science as a part of the cultural heritage of every educated person.

In the training of scientists and engineers the trend is from specialized courses to more basic courses. Thus an engineer thoroughly grounded in the basic principles of heat transfer and familiar with experimental data on the physical constants can apply his knowledge to new situations and new technologies, to the cooling of a radar transmitter tube, a nuclear reactor fuel element, or to a satellite and its equipment in the space environment. In the training of graduate students by participation in research the great emphasis is now on interdisciplinary groups applying the techniques of the several basic sciences to typical problems at the frontiers of knowledge.

The national defense and security in the space age has been the subject of much study and discussion. The freedom of space combined with the great power of nuclear energy for destruction forecasts the future development of weapons systems now only dimly understood. There are many applications already evident and under way as a responsibility of the Department of Defense.

Space exploration is a significant factor in international policy. One of the most interesting happenings in space today is the growing development of international cooperation in space exploration on a wide scale. The United States is cooperating with a growing number of nations in a variety of projects to increase knowledge of the earth's environment and of the universe and to realize the practical benefits of applications of space science and technology to peaceful purposes. We are conducting our experiments in the open. We are sharing our discoveries with the world community.

In March 1959 the United States offered through the Committee on Space Research of the International Council of Scientific Unions to cooperate with other nations in making available launching vehicles, spacecraft, technical guidance, and laboratory support for orbiting individual experiments for complete satellite payloads developed in other countries. The first satellites under this international program are being prepared by the United Kingdom and Canada and will be launched in the first half of calendar year 1962. Discussions are in progress with several other governments which have expressed interest in cooperative satellite projects. Cooperative space research is by no means limited to the more expensive satellite projects. Much valuable information can be obtained from the relatively cheap sounding rockets and such joint programs are under way with many countries.

In his recent speech before the United Nations President Kennedy said: "We shall urge proposals extending the United Nations Charter to the limit of man's exploration in the universe, preserving outer space for peaceful use; prohibiting weapons of mass destruction in space and on celestial bodies, and opening the mysteries and benefits of space to every nation. We shall propose further cooperative efforts between all nations in weather prediction and eventually in weather control. We shall propose, finally, a global system of communication satellites linking the whole world in telegraph and telephone, and radio and television."

Some social scientists have speculated that the exploration of space might become in time a substitute for war. Hope would be that the absorption of energies, resources, imagination and aggressiveness in the exploration of space might contribute to the maintenance of peace. Whether or not this speculation is warranted, I am sure from personal experience that international cooperation in the exploration of space does contribute to friendship and understanding among nations.

The influence of space exploration extends far beyond scientific, technological and economic development, education, and international relations. No area of human activity or thought has escaped, government, law, ethics, religion, in fact all human thought and aspirations. Even in the USSR we are told of the complaint of the Russian workman, who asked, "What do Sputniks give to a person like me?" The Sputniks can give everyone an expansion of his intellectual and spiritual horizons as he takes a longer view of man's role in time and space.

The large distances involved, long known to us from the work of astronomers, strike us with new force as we consider traversing them. Our nearest neighbor the moon, the immediate goal of the accelerated space program for this decade, is about 240,000 miles away. The nearest planet to us is Venus at 26 million miles; the next, Mars, at 49 million miles. The farthest planet, Pluto, is 3,680 million miles from the sun. The sun itself is 93 million miles from the earth.

To comprehend these tremendous distances by earth's standards, let us suppose that we had a manned spacecraft suitably equipped that could maintain its speed continuously at the burnout speed of the space probe Pioneer V, nearly seven miles per second, or 85 times the speed of a jet transport. It would take us about eight hours to reach the moon, 81 days to Mars, 153 days to the sun, and about 16 years to Pluto.

The nearest star is 25 quadrillion miles away, and travel to it at seven miles per second would require more than 100,000 years. Is travel of man to the stars then a futile dream? The vast reaches of the universe, our sun, the earth, the planets, the galaxies of stars have continued in their courses for billions of years before man appeared. Man is so tiny, his power so infinitesimal compared to the great forces of nature. Yet since the invention of writing, each generation of men builds on the shoulders of the past. The exploration of space has begun; who now can set limits to its future accomplishment?

Let's return from dreams to the earth and reality, from the future to the present. The exploration of space will go forward, if not by us, then by others. It is inconceivable that the United States will shrink from its proper role in the exploration of the new frontier regardless of the difficulties, costs and hazards. The hazards of not exploring are still greater -- the hazard of future technological obsolescence, the hazard of potential loss of leadership, the hazard of military surprise by potential enemies, if we fail to act. One of the participants in a forum at the recent Space Flight Report to the Nation by the American Rocket Society in New York was asked his opinion of the one single step which could do most to advance the space program of the United States. He replied, "The President of the United States has set for us a national goal. Let us go forward!"



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: IMMEDIATE

RELEASE NO. 61-234

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Remarks by
James E. Webb, Administrator
National Aeronautics and Space Administration
upon presentation of
The Freedom 7 Capsule
to the
Smithsonian Institution
October 23, 1961

* * *

Dr. Carmichael, Distinguished Guests, Ladies and Gentlemen:

It is a great privilege on behalf of the National Aeronautics and Space Administration to present to the Smithsonian Institution the Freedom 7 spacecraft.

Three years ago, on October 1, 1958, Project Mercury was organized. Six days later, the Space Task Group was established under Mr. Gilruth who is here today and who has served as its distinguished leader.

Three months later, the McDonnell Aircraft Corporation was selected to build the spacecraft, and two years later delivered the first prototype.

In March 1960, the first production spacecraft was delivered.

On May 5, 1961, the famous flight of Alan Shepard in the Freedom 7 was launched at the Atlantic Missile Range.

The Mercury capsule, in which Shepard made his flight, was recovered 15 minutes and 20 seconds later, 302 miles down range.

No project of this magnitude and complexity has ever been completed by our country in so short a time.

Power for the launch was provided by a modified Redstone rocket, 83 feet high, weighing 66,000 pounds, and developed by Dr. Wernher von Braun's team at the Marshall Space Flight Center. This rocket was built by the Chrysler Corporation.

The name, Freedom 7, was chosen by Alan Shepard for the Mercury capsule when he knew he would fly the first suborbital mission. It happens that in the Mercury program this is Spacecraft No. 7; the Redstone booster was No. 7; and of course, you all know seven of our nation's most experienced and able test pilots volunteered as astronauts for the Mercury program. All seven qualified and were eager to make this flight, as indeed, they are eager to make any future Mercury flights.

If to Alan Shepard the symbol "7" seemed appropriate, the word "Freedom" was also a happy choice. The full release and full play of the total power and capacity of the human being for high accomplishment is basic to the system of economic, social, and political organization which produced Project Mercury and Freedom 7. This system was able to marshal in the Space Task Group hundreds of able men and women. It permitted them to draw on the scientific, technical, and developmental resources of some 18,000 other men and women in the National Aeronautics and Space Administration and the worldwide facilities of a tracking and data acquisition network. It gave them the tremendous resources of the U.S. Air Force at the Atlantic Missile Range, the great capabilities of the U.S. Navy in its monitoring and retrieval responsibilities, and the backup of the many, many American companies who took part in this project.

At McDonnell Aircraft, nine hundred engineers and technicians were involved. Eleven major contractors were responsible for major parts, ranging from the escape rocket to the environmental control system.

The program also owes a debt of gratitude to the pioneering work and continuing efforts of Dr. Hugh Dryden and Dr. Abe Silverstein and to the organization that Dr. Keith Glennan instituted.

The reliable Redstone rocket was our first ballistic booster and has the distinction not only of powering the first Mercury manned suborbital flight, but also the first United States satellite, Explorer I.

In the old days, it was considered a good rule to have the engineer who designed a new airplane or made changes in it, to fly with the test pilot -- on the theory that the one who designed the machine should himself be ready to fly in it. From the size of the Mercury spacecraft you can see that this was not possible for Dr. von Braun, but I am sure both he and Mr. Gilruth were there in spirit.

Many scientists who, a year ago, were uncertain as to the role of man in the space environment are now developing strong views that the use of man to supplement machines and instruments in the exploration of space is essential. This stems from the fact that man can take with him his ability to observe the hitherto unknown, and form judgments, which instruments simply cannot accomplish.

The Mercury program is our first step in manned space flight. It will test the combined capacity of man and machine and will give us our first experience with extended weightlessness.

Balloonists have known for more than two centuries that something significant happens when man "breaks contact with the earth." In the lower ranges of balloon flight, men feel still attached to the earth, but as they proceed higher and the earth recedes and is left behind, there is the feeling of leaving normal surroundings and a definite break with the normal feeling of security. One important aspect beyond this is the psychology of man or men confined in space vehicles far from earth.

To Americans seeking answers, proof that man can survive in the hostile realm of space is not enough. A solid and meaningful foundation for public support and the basis for our Apollo man-in-space effort is that U.S. astronauts

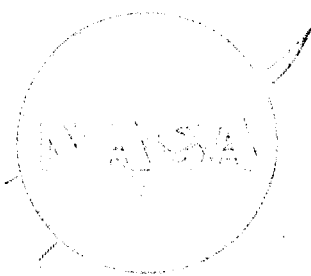
are going into space to do useful work in the cause of all their fellow men.

Such flights as those of Freedom 7 are not stunts. They are not antithetical to sober scientific and technological research. Interpreted properly, these dramatic events can add much to public understanding and excite creative interest in extending the base of knowledge on which public support must rest.

And this brings us to this presentation and this occasion: If, as has been said, "National recollection is the foundation of national character," the millions of Americans who come to the Smithsonian to see the instruments used to make real in action the hopes and dreams of our greatest men and women will find here, from this spacecraft Freedom 7 and a recollection of Alan Shepard's flight in it, an inspiration for character formation of the highest order.

So I am happy to present this spacecraft Freedom 7 to you, Dr. Carmichael, for the Smithsonian Institution.

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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: Monday AM's
October 30, 1961

Release No. 61-235

JULY CONTRACTS

The National Aeronautics and Space Administration awarded the following new contracts and research grants during July, 1961. The figures shown represent the total estimated cost of contracts of \$50,000 or more let during the month.

HEADQUARTERS Washington, D. C.

Cornell University (Ithaca, N.Y.)--\$63,000--Research on magnetometers for use on interplanetary space vehicles including studies, materials, circuits and components for flux-gate magnetometer.

National Research Corp. (Cambridge, Mass.)--\$98,000--Investigation of adhesion and cohesion of metals in ultra-high vacuum.

Stanford Research Institute (Menlo Park, Calif.)--\$187,000--Measure internal interference characteristics of satellite payload in the solar observatory program.

Commerce Dept., Bureau of Standards (Boulder, Colo.)--\$136,000--Research on electron content distribution and temperature variation in ionosphere by scintillation and far-day rotation of satellite radio transmission to spaced ground stations.

University of California (Berkeley, Calif.)--\$100,000--Research on techniques and instrumentation for measuring physiological variables in mammals under space flight conditions.

Rensselaer Polytechnic Institute (Troy, N.Y.)--\$160,000--Research in fundamental atomic chemistry with applications to upper atmosphere.

North American Aviation, Inc. (Canoga Park, Calif.)--
\$74,000--Analytical study of system integration problems.

National Engineering Science Co. (Pasadena, Calif.)--
\$71,000--Investigate thrust vector control by secondary
injection.

Army Ordnance Fuse Lab. (Washington, D. C.)--\$400,000--
Radiation resistant electrical component suitable for satel-
lites.

Aerospace Corp. (El Segundo, Calif.)--\$435,000--
Support of DOD-NASA large launch vehicle planning group.

AMES RESEARCH CENTER
Moffett Field, California

Electronic Associates (Long Branch, N.J.)--\$89,000--
Service and materials for simulator instrument consoles.

Comcor, Inc. (Denver, Colo.)--\$96,000--Maintenance and
repair of analog computers.

LEWIS RESEARCH CENTER
Cleveland, Ohio

Electronic Associates (Long Branch, N.J.)--\$184,000--
Analog computer system and major assemblies.

Steel & Alloy Tank Co. (Newark, N.J.)--\$50,000--Service
and materials for fabricating, welding assembly, machine,
vacuum test, and clean five-foot vacuum chamber.

LANGLEY RESEARCH CENTER
Langley Field, Virginia

A. O. Smith Corp. (New York, N.Y.)--\$195,000--Service
and materials to furnish 6600 P.S.I.G. helium storage field
hypersonic aerothermal dynamics facility.

Kahoe Co. (Bel Air, Md.)--\$261,000--Janitorial services
and washroom supplies.

J. F. Pritchard & Co.--\$124,000--Service and materials to
design, fabricate, deliver and install heat exchanger for
hypersonic aerothermal dynamics facility.

LANGLEY (Contd.)

Doyle & Russell (Norfolk, Va.)--\$989,000--Construct dynamics research laboratory.

Marquardt Corp. (Van Nuys, Calif.)--\$95,000--Booster heater system for 9x6-ft. thermal tunnel.

Trio Technology Co. (Burbank, Calif.)--\$64,000--Service and materials to design, fabricate and furnish a centrifuge acceleration test machine.

Task Corp. (Anaheim, Calif.)--\$110,000--Service and materials to design, fabricate, instrument and calibrate the internal strain gage balances.

International Business Machines (Norfolk, Va.)--\$71,000--For rent of electrical accounting machine/s/ and devices.

International Business Machines (Norfolk, Va.)--\$1,669,000--For rent of electrical accounting machine/s/ and devices.

International Business Machines (Norfolk, Va.)--\$1,771,000--For rent of electrical accounting machine/s/ and devices.

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

Electro-Mechanical Research Co. (Sarasota, Fla.)--\$50,000--Systems integration and support service/s/ for launch of the S-3A Centaur energetic particles.

Norair Engineering Corp. (Washington, D. C.)--\$157,000--Construct gate house and pump house.

Consolidated Electrodynamics (Arlington, Va.)--\$67,000--Recording/reproducer magnetic tape.

University of Wisconsin (Madison, Wisc.)--\$335,000--Design, develop, fabricate and test, the data reduction and evaluation of OAO experiment.

University of Alaska (College, Alaska)--\$60,000--Aberration of radio signals traversing the auroral ionosphere.

Western Electric Corp. (New York, N.Y.)--\$100,000--Communication equipment and services for engineering assistance of the Mercury ground network.

Electronics Engineering Corp. (Santa Anna, Calif.)--\$78,000--Modify computer format, control buffers, dual time decoder, and insert record mark option.

Consolidated Systems Co. (Monrovia, Calif.)--\$50,000--
Develop digital command decoder for satellites.

Computer Usage Co. (Washington, D.C.)--\$54,000--Hi-
speed orbit integrator program.

Massachusetts Institute of Technology (Cambridge, Mass.)--
\$400,000--Laboratory study for Apollo.

Department of Commerce (Washington, D.C.)--\$200,000--
Improve Glenn Dale Road, Baltimore-Washington Parkway to
Telegraph Road.

Department of Commerce, Bureau of Standards (Washington,
D.C.)--Systems requirement analysis.

SPACE TASK GROUP
Langley Field, Va.

McDonnell Aircraft Corp. (St. Louis, Mo.)--\$94,000--
Repair contract for Project Mercury.

North American Aviation, Inc. (Downey, Calif.)--\$100,000--
Design study of paraglide landing system for manned spacecraft.

Goodyear Aircraft Corp. (Akron, Ohio)--\$94,000--Design
study of paraglide landing system for manned spacecraft.

U.S. Air Force (Washington, D.C.)--\$175,000--Airlift
services.

U.S. Air Force, Systems Command (Patrick AFB, Fla.)--
\$135,000--Logistical support.

U.S. Air Force, Systems Command (Patrick AFB, Fla.)--
\$200,000--Project Mercury modifications, FY '62.

MARSHALL SPACE FLIGHT CENTER
Huntsville, Alabama

Rocket City Air Activity (Huntsville, Ala.)--\$190,000--
Air transport services.

Vitro Corp. of America (New York, N.Y.)--\$90,000--
Architectural and engineering services for addition to Bldg.
4619, Load Test Annex.

MARSHALL (Contd.)

Space Technology Laboratories (Los Angeles, Calif.)--
\$114,000--Analysis medium class vehicles.

Department of Commerce, Bureau of Standards (Boulder,
Colo.)--\$80,000--Liquid oxygen problems.

International Business Machines (Huntsville, Ala.)--
\$272,000--For rent of equipment.

-End-



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
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FOR RELEASE: Immediate
Wednesday, Oct. 25, 1961

RELEASE NO. 61-236

NASA SELECTS LAUNCH VEHICLE TEST SITE

The National Aeronautics and Space Administration today moved to acquire some 13,500 acres in southwest Mississippi as a static test facility for Saturn and Nova-class launch vehicles.

In addition, NASA will require easement rights to about 128,000 acres surrounding the test site, covering 103,000 acres in Pearl River and Hancock counties in Mississippi and 25,000 acres in Saint Tammany parish in Louisiana. The area is largely flat pine timberland.

The site is located about 35 miles from NASA's Michoud plant in New Orleans where large booster stages will be manufactured for use in the manned lunar Apollo program and other space projects. The Pearl River area was one of about 30 sites in the Gulf Coast area considered. The site selected will have deep-water access for booster transport to the Michoud plant via the Pearl River and the Intracoastal Waterway.

A half dozen or more stands capable of testing complete booster stages in the 1.5 to 20 million pound thrust range may be built at the Pearl River site.

Land acquisition and easements will cost an estimated \$13.5 million. Construction -- to begin within six months -- will require two to three years. The Mobile, Alabama, district of the U.S. Army Corps of Engineers will act as NASA's agent for land acquisition in cooperation with the Lands Division of the Department of Justice.

Court actions filed today in U.S. District courts in Jackson, Miss., and New Orleans, La., described the perimeters of the land involved.

Approximately 85 families reside in the 13,500-acre test site area where construction is to begin next spring. Another 575 families dwell in the 128,000-acre buffer area. Those people would have up to two and a half years to move out of the area. Restrictions on land use would rule out residences in the easement zone but would not interfere with farming, lumbering, grazing or mineral operations there.

When in operation, the facility would employ 500 to 1,000 engineers, technicians and support workers. Operation of the site will be under the direction of NASA's Marshall Space Flight Center, Huntsville, Ala.



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NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: Friday PM's
October 27, 1961

RELEASE NO. 61-237

NASA EMPLOYEES HONORED FOR SERVICE

Three National Aeronautics and Space Administration employees were honored today for their outstanding contributions to the space program at the agency's second annual awards ceremony at the USO Club.

Dr. Abe Silverstein, who recently was named director of the Lewis Research Center, Cleveland, Ohio, received an Outstanding Leadership award for "his untiring efforts in formulating, implementing, and directing diverse elements of the NASA space program; developing space flight centers, and for his infinite capacity and ability to make incisive analyses and sound decisions."

William J. O'Sullivan, Jr., Assistant to the Chief, Applied Materials and Physics Division, Langley Research Center, Langley Field, Va., received the Exceptional Scientific Achievement award for his concept of inflatable space vehicles and for his direction of the design and development of the first passive communication satellite, Echo I.

George D. McCauley, NASA safety officer in Washington, received the Sustained Superior Performance award for his accomplishments in NASA's accident prevention and safety programs. In June this year, NASA received the President's Safety Award for 1960 for the most outstanding record of performance and accomplishment in occupational injury prevention.

The awards, presented by James E. Webb, NASA Administrator, covered a period from Oct. 1, 1960 to Sept. 30, 1961.

Over

NASA's highest awards, the Distinguished Service awards, were presented earlier to Alan B. Shepard, Jr., and Virgil I. Grissom, the nation's first two astronauts to make suborbital space flights.

Outstanding Leadership awards were also presented earlier to the late Edward R. Sharp, former director of the Lewis Research Center and Henry J. E. Reid, former director of the Langley Research Center.

Three NASA employees today also received 30-year service pins. They are Francis Dorsey, Telecommunications, Mail and Records Branch; Carl Freedman, Director of Administration, and Albert Von Doenhoff, Spacecraft Technology. Mr. Von Doenhoff served all 30 years with the National Advisory Committee for Aeronautics and NASA.

Fifty-seven employees received 20-year service pins, 74 received 15-year service pins and 67 received 10-year service pins.

October 27, 1961

STATEMENT BY JAMES E. WEBB FOLLOWING
SATURN LAUNCH

"The flight today was a splendid demonstration of the strength of our national space program and an important milestone in the buildup of our national capacity to launch heavy payloads necessary to carry out the program projected by President Kennedy on May 25th. We in NASA deeply appreciate the contribution by the military services and American industry in achieving this important milestone. I have already expressed my appreciation to Dr. Wernher von Braun and Dr. Kurt Debus for the work of their two great teams."

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Presented at Flight Safety Foundation International Air Safety Seminar 1961

NASA IN AERONAUTICAL RESEARCH .

by

George P. Bates, Jr.

National Aeronautics and Space Administration

Washington, D. C.

"NASA IN AERONAUTICAL RESEARCH"

Presented at Flight Safety Foundation International Air Safety Seminar 1961

Naples, Italy

November 1961

George P. Bates, Jr.

NASA Headquarters, Washington, D. C.

The Flight Safety Foundation asked me to discuss aeronautical research in general and did not ask me to limit this discussion to conventional safety research. This arrangement, indeed, fits well with my philosophy that nearly all research on aircraft which improves the operational capability and efficiency of an airplane is safety research. For example, certainly research to produce better aerodynamic qualities, piloting qualities, control systems, structures, and flight procedures can be considered as safety research.

Safety is only one aspect of a useful and profitable air transportation system. Airplanes must be safe if they are to entice any passengers, but also the airplane must fly when passengers want to fly and must go from place to place that passengers wish to travel. Furthermore, they must do this on time; i.e., reliability is integral with safety for the advancement

of aviation. Some people have indicated that aviation is reaching a plateau in its growth. With this I cannot agree. In fact, aviation, to me, is still in its infancy. It has already revolutionized our business techniques, especially in the United States. But the growth potential of aviation appears even greater to me. It is essential, however, that for aviation to reach future goals, it must become an integrated transportation system, operating when expected to operate almost without fail. Obviously, the world's airlines have not reached this state of perfection; indeed, there is a vast amount of research and development that must still be done in order to reach the goals we expect for aviation.

The NASA is engaged in scientific aeronautical research as distinguished from aeronautical vehicle development. Its research includes basic studies to increase scientific knowledge pertaining to aircraft as well as applied research and specific analytical or experimental tasks undertaken to solve critical problems encountered by the designers and operators of aircraft. In all of our research we have three primary objectives: (1) to provide scientific knowledge and evolve new concepts of flight, (2) to provide applied research information necessary to support advanced aircraft development, and (3) to assist the operators of aircraft in the solution of current scientific and technical problems. We do not design or develop aircraft; these functions are the missions of other U. S. Government agencies or private business activities. Nevertheless, we do not consider our research completed until it has been reduced to practice, and we accordingly provide much technical assistance for those who develop and operate aircraft.

Now I will discuss a few of the specific research programs that are

underway in the NASA. Many of you are aware of our research programs on V/STOL vehicles and on supersonic transports. While there is certainly no similarity between the two vehicles, the two programs do have a very close interrelation so far as the aeronautical industry is concerned, particularly in air transportation. The supersonic transport will further decrease the air travel time between various points on this globe; however, it is obvious that great strides remain to be made in improving short haul air transportation and city-center-to-airport transportation. Here, the V/STOL vehicle may have a great future.

The purpose of the NASA program has been to advance the state of the art with regard to V/STOL vehicles. The primary problems concern their stability and control. My first slide shows three of many types of configurations being studied by the NASA in flight and in wind tunnels. Starting at the top, we have the tilt-wing propeller configuration; in the center is a deflected jet aircraft; the lower picture is of the ducted-fan-type V/STOL vehicle. The major problems on which the NASA is working pertain to flying qualities which include stability, controllability and general pilot handling characteristics under all flight conditions, hovering control, and the unique operational problems of these unusual flight vehicles. We believe that our program has proceeded to where information is now available to build aircraft for operational testing and evaluation. Probably with some modification, these designs could become useful military aircraft. Experience to be gained in operating a small number of such aircraft is needed to guide the next stage of V/STOL research. The United States Department of Defense is now actively engaged in the procurement of some V/STOL vehicles for this purpose. More

research, both in laboratories and in flight, is required to permit design of V/STOL aircraft types that will have reasonable utility, efficiency, and productability for commercial use. The NASA does plan to continue its research toward those goals.

Now let us consider the supersonic transport. Speed is not the answer to all of aviation's problems; however, I am convinced that a supersonic commercial transport is technically and economically feasible and that it will be sociologically compatible with modern habits and requirements. When this vehicle will become operative depends on many questions. The NASA is presently involved in a cooperative program with the Department of Defense and the Federal Aviation Agency for undertaking the research and development which will lead to a commercial supersonic transport by 1970. The NASA's role on this team is its classical role of supplying the basic information required by industry to design the vehicle. We are not interested in designing the vehicle. Furthermore, the NASA is not going to buy the vehicle; therefore we are simply providing a service to both manufacturers and purchasers. At present it appears that several years of good hard research are required before any prototype design studies are initiated. Parametric studies are certainly required, and various companies throughout the world are involved in these at present. All three members of this U. S. Government team working on the supersonic transport expect direct cooperation and assistance from manufacturers and airlines as this program progresses.

This supersonic transport program is one of the larger aeronautical efforts now underway within the NASA. Figure 2 is a picture of a proposed

transport configuration and lists some of the primary problem areas. One area concerns general aerodynamic problems, including configurations and their attendant stability characteristics and the all-important problem of lift-drag considerations. We have a comprehensive wind tunnel investigation underway on configurations for the supersonic transport. The program does include detailed studies of variable sweep configurations because it is apparent that some means must be provided to have good stability characteristics at low speeds as well as at cruise, and such characteristics are not readily obtainable with conventional configurations.

A large supersonic transport airplane as now envisioned may well be a Mach 3 machine. This means that the skin of the airplane will be subjected to temperatures as high as 600° F. as indicated in Figure 3. If the supersonic transport is to be economically feasible, it must have a flight life of approximately 30,000 hours, in cyclic periods of 2 to 3 hours. The NASA is exploring the problem of adequate materials for such an airplane with particular attention to deterioration of materials with long heating times.

The propulsion system for a supersonic transport is another problem that obviously requires a considerable amount of research. It appears that engines now available or foreseen for development in the near future may not be the answer for a commercial supersonic transport. This means that something like a turbofan-ramjet engine may be required for maximum economy and efficiency. Much research remains to be done on this problem however.

Another area of importance is operating problems. Certain aspects of the operation of the supersonic transport can make or break the vehicle. It appears mandatory that this vehicle be designed with all aspects of its operation in mind and that it not be just another aircraft handed to the pilot who

is told "here - fly this from Rome to Washington."

Three operational problems that appear vital to us are sonic noise, radiation or environment, and flying and handling qualities. The NASA, together with the FAA and the Air Force, has underway a flight research program to give us further information on sonic noise parameters; in particular the effects of lift, maneuvers, and of high altitude. The NASA has done earlier experimental work on sonic booms and has developed a good understanding of many of the associated parameters; however, this additional work is required to obtain the necessary information to estimate properly the sonic noise problem related to supersonic transports. I believe that reflected noise pressure on the ground of approximately 1 lb/sq ft, which is about the level of thunder, is a reasonably low level for supersonic operations. The achievement of this level will require that future supersonic transports operate at subsonic speeds until at high altitude - 40,000 feet or higher - and that the vehicle cruise at altitudes well over 60,000 feet. To achieve such operational latitudes, it is evident that noise considerations will have a large influence on supersonic transport operations and on the design of the propulsion system and airframe configurations. This noise may well force us to go to higher velocities on a supersonic transport, as going from Mach 2 to Mach 3 increases the efficient cruise altitude by at least 10,000 feet. Maybe we'll need to go to Mach 4 to get another 10,000 feet because I have seen various estimates that the ground level boom pressure for a large vehicle at 70,000-foot altitude may be as high as 2 lb/sq ft. While such pressures may not break all windows between here and London, they will wake up most of the people. Frankly, I believe that is unacceptable.

We have some hope that at extremely high altitudes - over 60,000 feet - the attenuation of the shock wave may be higher than it is at lower altitudes; however, there are very few data to confirm this. Our program at present involves flights with high performance-large supersonic transport aircraft over a T-shaped ground measurement range in the flat California desert that is 4 miles along the flight path and 20 miles to the side. Detailed pressure measurements are made, and we have precise knowledge of the aircraft's location even during maneuvers. We have already discovered that a supersonic airplane in accelerating in straight and level flight produces double the boom pressure that it makes during steady-state conditions and that a turn can increase the boom pressure as much as four times. It appears probable that on ascent and descent of a supersonic transport we must alleviate the boom effect on the ground by proper control of the flight path; however, I believe that the sonic boom can be alleviated for commercial aircraft.

Let us consider the radiation problem. At the Flight Safety Seminar last year the effects of cosmic radiation on the supersonic transport and its occupants were discussed. From all available data I do not believe that natural radiation poses any hazards for crew or passengers for a supersonic transport cruising at latitudes below 50° geomagnetic. For latitudes above 50° geomagnetic, the hazard is a very infrequent one because of proton events related to solar flares. For solar flares producing high energy proton events, which occur with a maximum of one or two every 4 years but can occur in fairly rapid succession, the dosage rate could be 4 reps per hour for occupants of an aircraft at 75,000 feet. The high energy intensity lasts for about one hour. This dosage rate is not necessarily detrimental but is as high as you would

wish to allow for passengers and, more particularly, for the crew which might be subjected to repetitive dosage. For the cases where such high energy events occur, several alternates can be followed. The aircraft can proceed to its destination if the crew has not previously encountered medium- or high-energy proton events during the year, which is a most likely probability; or, to be completely safe, the vehicle can descend to 50,000 feet for the remainder of the flight where the shielding effect of the atmosphere will decrease the radiation dosage rate drastically. A third possibility is to have the vehicle change its flight path to get back under the earth's magnetic shield.

As we are improving our ability to predict solar flares, it may well be that the crew will know that a solar flare may occur during the course of their flight and will, therefore, use a flight plan that keeps them under the magnetic shield of the earth; i.e., there should be no transpolar flights under such conditions. The flare occurrence can easily be detected by solar patrols here on earth, by instrumentation onboard the vehicle, or by satellites around the earth which are monitoring x-radiation wave lengths. Proton events occur infrequently and do not always follow a solar flare. They will be considered as an operational problem for the supersonic transport in the same way as severe weather is now considered for commercial aviation.

I do not believe that any form of radiation shielding will be required for the supersonic transport.

Another difficult problem area for the supersonic transport is the assessment of the desired flying and handling qualities. By flying and handling qualities, I mean the determination of factors such as static stability, dynamic stability, stall characteristics, trim changes, control

effectiveness throughout the speed range, control force characteristics, maneuver capabilities, buffet characteristics for instability boundaries, gust response, stability augmentation and dampers, aeroelastic effects as related to the control system, and piloting precision in all of its variations, with the relation of all of these parameters to the pilot's capability to handle the machine as the dominant factor.

Our research on flying and handling qualities involves the use of both simulators and aircraft. As soon as our aerodynamic staff completes its calculations and experiments on a proposed configuration, the stability derivatives for the proposed configuration are computed and then fixed-base simulators are used to study the flying and handling qualities of the proposed vehicle. Most of our fixed-base simulators used for such work are closed-loop operations involving a trained test pilot, cockpit, and an analog computer. Our research program on configurations thus becomes a closed-loop affair with the results of our simulator studies of flying and handling qualities being fed back to improve the proposed configurations. We also hope to use more complex multi-occupant simulators with and without motion to study in detail the various piloting problems associated with the supersonic transport. We will soon have in operation at our Ames Research Center a 5-degree-of-freedom simulator that can be used for piloting studies. This simulator program encompasses studies of the piloting problems during takeoff and landing as well as during cruise flight and includes considerations of the effects of air traffic control.

As a parallel program, we are also undertaking flight investigations of the flying and handling qualities problem. A variable stability F-100C is

being used in some of these studies, and we propose to use other large supersonic aircraft for detailed studies in flight of proposed supersonic operations. Even the X-15, which has now reached a speed of 3900 miles an hour and an altitude of 217,000 feet, is furnishing valuable information on piloting as well as aerodynamic and structural aspects of the supersonic transport.

While I am quite optimistic about the supersonic transport, you will note that I have identified a host of difficult research problems which must be solved before such a vehicle becomes a practical article for commercial usage.

Let me turn to another subject which is more directly aligned with the particular area called flight safety. Here I refer to our VGH program. For many years the NASA, with the cooperation of various airlines, has been making a statistical study of gust spectrums by measuring the accelerations imposed on aircraft during their routine operations. These measurements were made with an automatic recorder (called the VGH recorder) placed onboard the aircraft which measured normal acceleration, airspeed, and altitude. Concurrent with the introduction of turbine-powered airplanes into commercial transport operations, the NASA broadened its original program in order to obtain statistical data on a number of operational aspects of turbine-powered transports, such as airspeed operating practices, performance during landing and takeoff, as well as inflight and ground loads.

The program encompasses the collection of statistical data from several types of turboprop and turbojet transports operating on a number of domestic and transoceanic routes. These routes were selected so as to provide a representative sampling of United States airline operations. In addition, data

are being collected from one foreign airline engaged in transoceanic operations. The next slide, (4), will give you an indication of the types of aircraft on which we have obtained this data to date and the number of flight hours we have on each type of aircraft.

While our program is continuing, evaluation of the records obtained so far has provided significant information regarding several aspects of the operations of turboprop and turbojet airplanes. As indicated in slide 5, data on airspeed operating practices, landing contact conditions, oscillatory acceleration, unusual flight events, as well as gust and maneuver loads have been obtained. Slide 6 shows the oscillatory accelerations on a 4-engine turboprop aircraft as well as a typical VGH record. We are not positive what causes all of these oscillations; however, the oscillations do have serious implications regarding passenger comfort, structural fatigue, aircraft vertical separation, operating speed margins, and the design of future, higher-speed vehicles. NASA data show that longitudinal and lateral oscillations have occurred in each type of airplane on which we have data. In general, these oscillations occurred randomly and did not appear to be associated with any particular airspeed-altitude combination. Airplane type, manufacturer, atmospheric conditions, etc., are not significant factors. While we cannot detect from our records whether the autopilot was or was not engaged, we believe that the oscillations occurred with and without the autopilot engaged but that the majority occurred when the autopilot was in operation. The oscillations in some cases occurred from a couple of minutes in duration to entire flights up to 3 or 4 hours. In general, these oscillations occur at a very low frequency, approximately 4 a minute; however, I have been on

various jets where the period has been as low as one a minute. These are difficult for a pilot to detect unless he is watching the horizon or, more accurately, watching his instruments. Maximum incremental accelerations during constant amplitude-type oscillations have been recorded at levels of as much as $\pm 1/2g$. One airplane experienced oscillations which started at about $\pm .8g$ and lasted 1-1/2 minutes. The oscillations appear to occur primarily during cruise but also occasionally during climb and descent. The periods of the predominantly constant-frequency longitudinal oscillations noted in our data can result from autopilot operation with defective auto-trim servos or out-of-tolerance altitude sensors or related equipment. Poor maintenance on the overall control system reflected by the increased friction in the system, which tends to reduce the authority of the autopilot, also is a contributing factor. Simply, it means that the control systems and the autopilot have been designed to operate much closer to their limits than before on other vehicles, and the oscillations are a result of wear and loosening up of the entire system. A review of our data has shown that there has been no real improvement in the oscillation conditions during the period of our records. Airplanes which oscillated at the beginning of the period generally still were oscillating at the time the last records were taken. Sometimes, improvements are noticed after major overhauls wherein both the autopilot and the control system had been worked over. It is obvious that detailed changes should be developed for autopilot and pitch control systems so as to help eliminate these oscillations. The surprise is at the high magnitude of accelerations sometimes recorded during flights which, the NASA understands, were routine, commercial flights. Of course, there are times

when our records show other highly unusual oscillations as indicated in the next slide (7) which is for a twin-piston-engine transport. In checking back on this we found a very human explanation. It seemed that the ship was being ferried with just pilot, co-pilot, and stewardess on board. The pilot went in the back to talk to the stewardess for awhile. This irritated the co-pilot, maybe he was jealous, and he proceeded to rock the stick back and forth so as to porpoise the airplane - a very human problem.

For several years, the NASA has been reporting to the industry that turbine-powered airplanes are being operated above placard speeds, considerably more often than reciprocating-engine airplanes particularly in the limit range. Although operators have been alerted to this situation, our records indicate that there has been no overall improvement in this situation as yet. There are new rules and training procedures being adopted in the United States which are designed to help eliminate this overspeed problem. We certainly hope that this is successful because these airplanes are not designed to operate for prolonged periods of time at speeds in excess of their placard speeds. The reasons for these overspeeds may be many. Mostly it is that these airplanes are very clean and can very quickly pick up speed when the pilot either does not pull back power quickly when topping out on a climb or else when he inadvertently increases his power or noses over.

Our VGH records as well as camera measurements have been used to study landing contact conditions for turbine-powered transports in routine commercial operations. Special cameras were used at the end of a runway to photograph landings of transports. The contact conditions determined from the photographs included vertical sink velocity, forward speed, rolling velocity,

bank angle, and the distance of the point of touchdown from the runway threshold. The VGH records have been evaluated for vehicle forward speed and for vertical acceleration at impact and immediately prior to impact. In general, both techniques have indicated that the sinking speeds at touchdown are slightly higher for turboprops and appreciably higher for turbojets than for piston engine transports. This trend is shown in the next slide (8). The slower engine response characteristics of the turbojet coupled with the higher landing speeds and a possible tendency by pilots not to fully round out the flare prior to touchdown in order to put the airplane on the runway at the earliest possible moment have been discussed as possible causes for the higher maximum sinking speeds for the turbojets. Although the margin between design limits and operating practices on sinking speeds may be somewhat smaller for turbojets than for turbine-piston engine transports, there is no evidence to indicate that the present design limits are not satisfactory for the turbojets. We wonder, however, whether or not future airplanes may not have to be designed for higher sinking speeds if this trend is to continue.

We have analyzed this sinking speed data from many directions to try and determine exactly why this is occurring. We have even had our pilots work with airline pilots flying modern simulators to try and determine the actual cause for these increases in sinking speeds. So far we have not been able to definitely tie this to any one factor; however, I would like to show you two more slides which may be related to this problem. The first chart (9) is a probability distribution of forward speeds at touchdown showing the percent above stalling speed for 3 turbine-powered type aircraft and a piston aircraft. While the turbine-powered aircraft may be touching down at higher

forward velocities, they are landing at a lower percentage above stall speed than do the older piston transports. The next chart (10) gives the percent above stalling speed for the same airplane being flown by two different airlines and indicates the differences between airline operating practices. One airline is landing at 35% above stall; the other one at 40% above stall. The next chart (11) shows that on these same airlines, the airline having the higher percentage over stall landing speed had, in general, the lower sink speed. This same trend is true throughout all of our studies. This indicates that the higher sink speed on the jets is partially related to training. However, we certainly do not wish to say that the vehicle coming in at a higher speed is necessarily making the safer landing. This is a matter that has to be considered in each individual case and airport. The higher the speed, the lower the sink rate, but the higher the kinetic energy of the vehicle making the landing.

One last project concerns a joint FAA-NASA investigation to determine the effects of slush on the takeoff characteristics of jets and to determine runway braking characteristics of various aircraft under all conditions. The first part of that project is a continuation of the scale-test made at our Langley Research Center and reported to you last year wherein we ran tires through a bed of slush, using our Landing Loads Track. For the recent tests, a brand new Convair 880 aircraft was utilized at the FAA facility at Atlantic City. A strip of slush up to 2 inches deep, 50 feet wide, and 1000 feet long was placed on the runway. The aircraft was accelerated to 160 knots, engines cut to idle, and the vehicle allowed to roll through the slush. The performance of the vehicle was measured by accelerometers placed within the

aircraft and by radar and optical tracking techniques. The data from these tests have not been fully analyzed as yet; however, it appears that they may validate the general rule obtained from our earlier tests that 1/2 inch of slush is approximately equal to 1000 feet of extra runway for the takeoff run of a turbojet; however, the drag appeared to be higher than predicted. At high speed above 120 knots the tires planed with a resulting decrease in drag but not so low a drag as on a dry runway. This means that if the jet gets up to tire planing speed, the remainder of the takeoff run will be less critical provided you still have enough runway - but will you have enough power to plane? In observing these tests, I noticed two major problems. One, you can't determine the effective amount of slush on the runway with a ruler; you will have to utilize some type of test vehicle going through the slush actually measuring the retardation force. The second is the damage potential of the slush to the vehicle. While extreme care was exercised not to damage the 880, on each high-speed run through slush an appreciable amount of slush was thrown up into all openings on the vehicle except the engine inlet. I particularly noticed that the cavity behind the leading edge flap was packing very heavily with slush. If this had been a takeoff through that material on a day with temperatures near freezing on the ground, when the ship began to climb it might have encountered some difficulty in getting these flaps closed unless the leading edge heating mechanism could have handled this rather heavy load.

Tire braking tests are being made on dry and wet runways as well as runways covered with slush and foam. The tests are being made by several techniques. The British tire friction cart was flown over to the United

States, and much joy was had by all in watching a Jaguar trailing this friction cart through the slush at 130 miles an hour. The Swedish tire friction cart is also being evaluated in these tests. The NASA has instrumented a station wagon with special tires. This is being run at Atlantic City, and all 3 vehicles will also be tested on our Landing Loads Track at Langley to try and establish a uniform technique for measuring braking effectiveness and rolling resistance on various surfaces.

I am certain that there are many questions left unanswered concerning the broad magnitude in the NASA research program pertaining to aeronautics; however, I, as well as any of my fellow NASA staff members, will be glad to discuss your questions on aeronautical research.

Thank you.

FIGURE 1

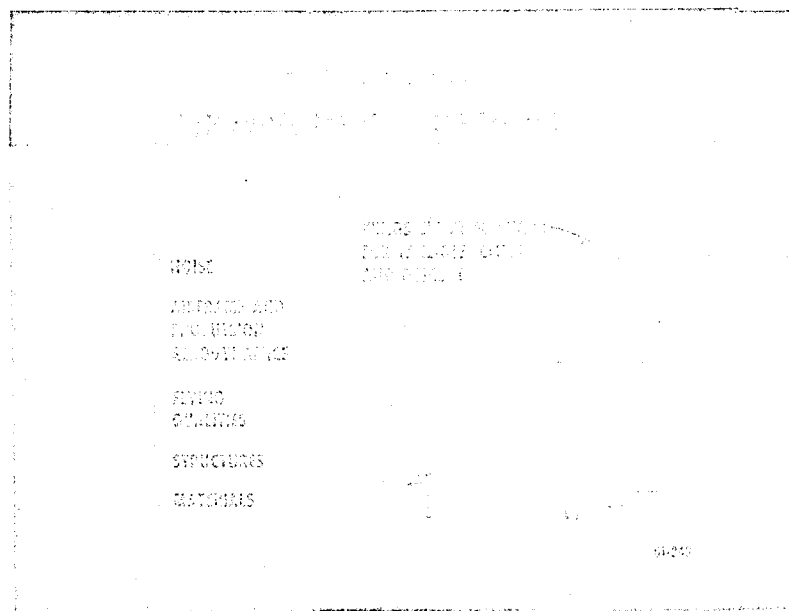


FIGURE 2

FIGURE 3

Alphabet	Score	Alphabet	Scoring Table Score
Boring	A	A	50
TO		B	200
TO	C	C	100
TO	D	D	1000
		E	50
		F	100
		G	2000
TO-SS	A	H	100
TO-B	B	I	100
		J	100
TO-B	C	K	1000
		L	100
TO-B	D	M	100
		N	100
TO-B	E	O	100
		P	100
TO-B	F	Q	100
		R	100
TO-B	A	S	100
TO-B	B	T	100
TO-B	C	U	100
TO-B	D	V	100
TO-B	E	W	100
TO-B	F	X	100
TO-B	G	Y	100
TO-B	H	Z	100
TO-B	I		100
TO-B	J		100
TO-B	K		100
TO-B	L		100
TO-B	M		100
TO-B	N		100
TO-B	O		100
TO-B	P		100
TO-B	Q		100
TO-B	R		100
TO-B	S		100
TO-B	T		100
TO-B	U		100
TO-B	V		100
TO-B	W		100
TO-B	X		100
TO-B	Y		100
TO-B	Z		100

Figure 4. Nash VotE Program = 1.01

FIGURE 4

INFORMATION FROM VGH RECORDS

LOADS		PERFORMANCE
GUSTS	} VARIATION WITH: AIRSPEED ALTITUDE FLIGHT CONDITION	ROTATIONAL SPEED
MANEUVERS		TAKE-OFF SPEED
LANDING IMPACT		SINKING SPEED
TAXI		LANDING SPEED
AUTO-PILOT INPUTS		TAKE-OFF DISTANCE, THRUST /WEIGHT RATIO, RATES OF CLIMB AND DESCENT
OPERATIONAL		UNUSUAL OCCURANCES
AIRSPEED DISTRIBUTION BY FLIGHT CONDITION		AUTO-PILOT MALFUNCTION
ALTITUDE		FLIGHT EMERGENCIES
AIRSPEEDS IN ROUGH AIR		PILOT INCAPACITATION
PLACARD SPEED EXCEEDENCES		EMERGENCY DESCENT
FLIGHT PROFILES		ABORTED TAKE-OFF

FIGURE 5

OSCILLATORY ACCELERATION ON 4-ENGINE TURBOPROP AIRPLANE

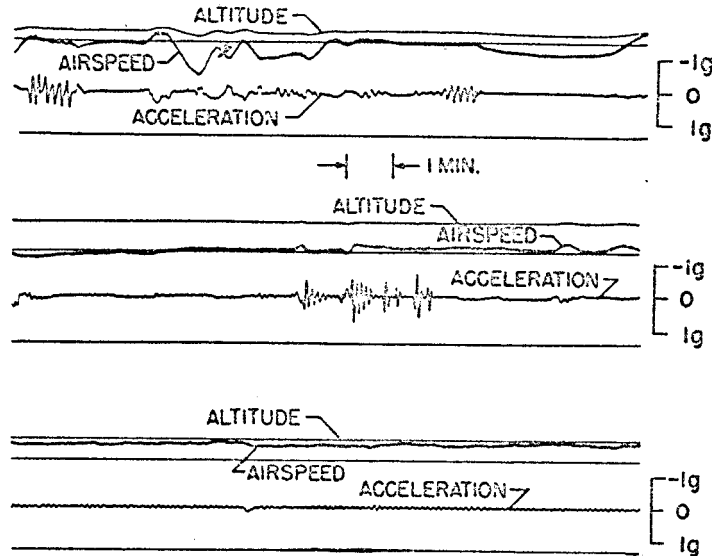


FIGURE 6

OSCILLATORY ACCELERATIONS ON A TWO-ENGINE PISTON TRANSPORT

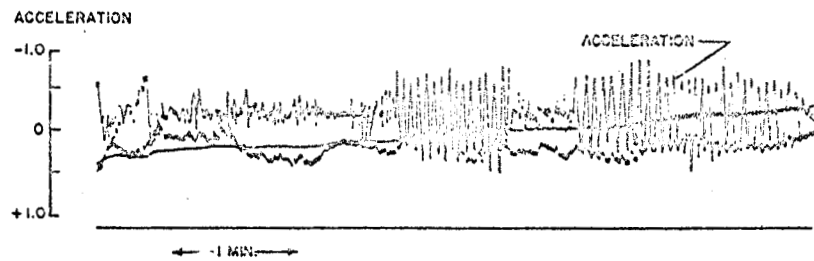


FIGURE 7

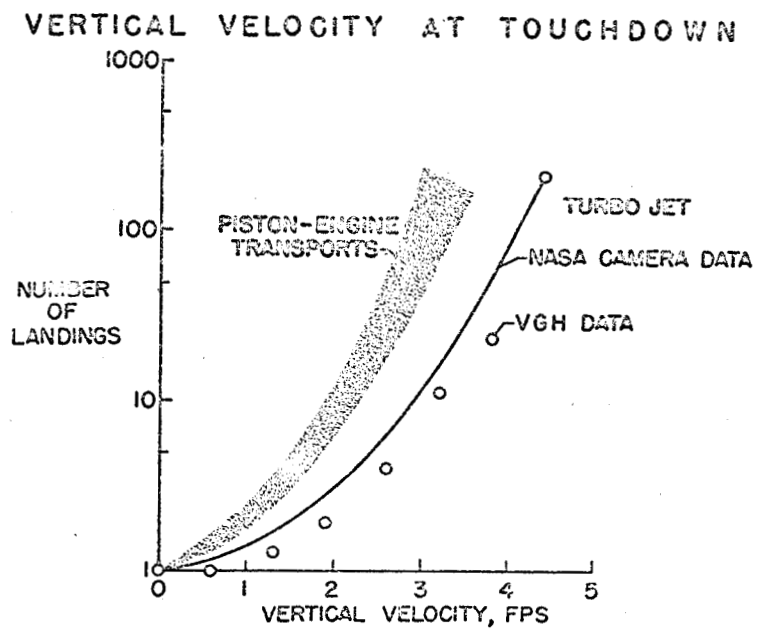


FIGURE 8

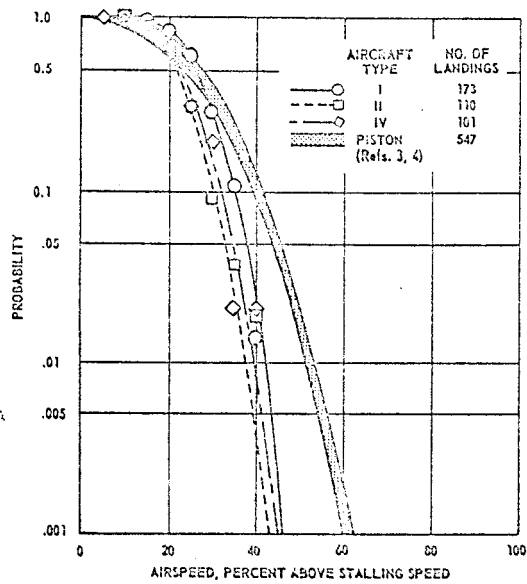


FIGURE 9 - PROBABILITY DISTRIBUTIONS OF AIRSPEED IN PERCENT ABOVE STALLING SPEED AT TOUCHDOWN FOR THREE TURBINE POWERED TRANSPORTS AND A RANGE OF VALVES FOR PISTON ENGINE TRANSPORTS.

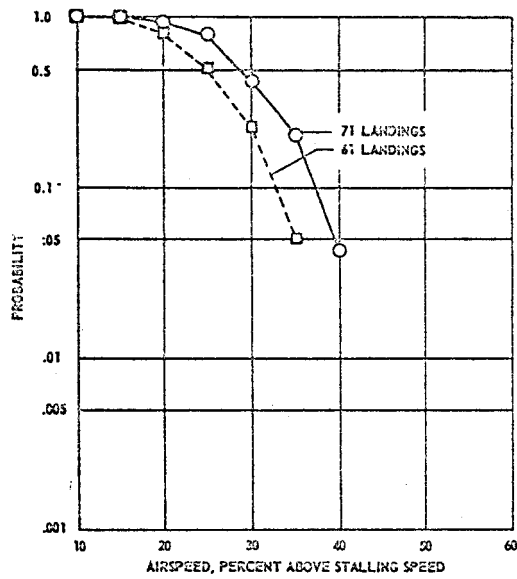


FIGURE 10 - PROBABILITY DISTRIBUTIONS OF AIRSPEED IN PERCENT ABOVE STALLING SPEED AT TOUCHDOWN FOR TWO OPERATORS OF TYPE I TRANSPORTS

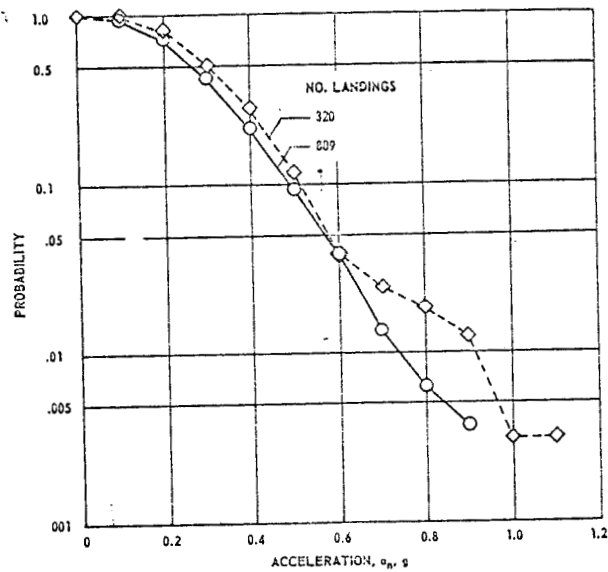


FIGURE 11 - LANDING IMPACT INCREMENTAL ACCELERATIONS
EXPERIENCED BY TWO OPERATORS OF THE SAME
TYPE TURBOJET AIRCRAFT



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: IMMEDIATE

SUNDAY October 29, 1961

RELEASE NO. 61-239

MERCURY-SCOUT I

In preparation for Project Mercury orbital flights, a 150-pound, cigar-shaped satellite carrying communications components similar to those in Project Mercury spacecraft, will be placed in an elliptical earth orbit in the next few weeks. Purpose of the test is to verify the readiness of Mercury's worldwide network of tracking stations.

A four-stage, solid-propellant launch vehicle will be used to place the payload in orbit. The test, known as Mercury-Scout I, is to be conducted from launch complex 18 at Cape Canaveral, Florida, by the National Aeronautics and Space Administration.

The Scout vehicle is to be launched on an azimuth of about 72 degrees. It will be guided in the early phase of flight by an autopilot. Prior to separation of the fourth stages, the fourth stage and payload will be spun at a rate of 160 r.p.m. by the small solid-propellant rockets, stabilizing the payload carrier. Throughout powered flight, vehicle performance data will be telemetered to the ground.

Approximately 1,000 miles downrange from the launch site, at an altitude of about 240 statute miles (perigee), the payload will be inserted into an orbit carrying it as far as 400 miles from earth and about 32 degrees north and south of the equator.

During the first three orbits, the satellite's equipment will broadcast signals which are to be picked up by the network stations. Thereafter, for a period of 18-1/2 hours, most of the equipment will be shut down by ground command to conserve power, assess initial mission data, and make any adjustments necessary in the tracking and data acquisition equipment.

The satellite may be reactivated for a second mission of three orbits before being turned off again. It is possible that a third and fourth three-orbit exercise may be conducted before the payload battery runs down.

No attempt will be made to recover the satellite.

In addition to providing a "live" training exercise for the Mercury Tracking Network, the mission is to test real-time orbital computing capability of the Goddard Space Flight Center, Greenbelt, Maryland, and the communication system linking Goddard with Mercury's range stations. Goddard serves as the data center for Mercury and other NASA space missions.

Aeronutronic, contractor to the Air Force Space Systems Division, assembled and tested the payload under NASA technical supervision. The package contains Mercury instrumentation provided by McDonnell Aircraft Corporation, prime NASA contractor for Project Mercury spacecraft.

Included in the payload are: C- and S-band radar beacons, two telemetry transmitters, two command receivers and two Minitrack beacons. The power supply for the payload is a standard Mercury battery. There are no voice tapes aboard.

The payload itself measures 12 by 12 by 17 inches and will remain attached to the 64-pound burned-out fourth stage casing. Total weight in orbit will be 214 pounds.

Technical support for the Mercury-Scout I mission will be provided by Space Task Group, the Air Force, McDonnell Aircraft Corporation, Aeronutronic, Langley Research Center and Goddard.

Mission Operations Director will be Walter C. Williams, Associate Director, Space Task Group. Project Officer representing the Air Force in this test will be Lt. Col. J. G. Henry, 6555th Test Wing (Development). Mr. Williams will direct the flight operation from the Mercury Control Center and Colonel Henry will supervise the launch from the blockhouse.

Project engineers for Mercury-Scout I are Lewis R. Fisher and James T. Rose, Space Task Group and W. J. Boyer is test program Coordinator from Langley Research Center.

THE MERCURY RANGE

The orbit selected for Project Mercury passes just south of Bermuda, south of the Canary Islands, across Africa, the Indian Ocean and the Australian Range at Woomera. The track then continues across the Solomon and Phoenix Islands, and to within close proximity of Hawaii. The orbit then intersects the North American coast and passes over the Southern United States. U.S. tracking sites include Pt. Arguello, Calif., White Sands, N. Mex., Corpus Christi, Tex., and Eglin, Fla., as well as the Cape Canaveral Mercury complex.

In making the choice of the number and location of the various ground stations (requiring in some cases completely new complexes and in other cases additions to existing equipment,) a number of ground rules were established, including:

1. A requirement for essentially continuous radar, telemetry, and voice communications coverage from Hawaii through Bermuda.
2. The ability to reset the Mercury spacecraft retrorocket timer conveniently on each orbit as well as have direct ground command of the retrofiring during each orbit.
3. The need for continuous contact with the spacecraft during launch and a reasonable length of time following orbital insertion.
4. A desire to maintain frequent voice and telemetry contact with the spacecraft.
5. The need for continuous landing point prediction in case of an early abort requiring landing in the Atlantic Ocean or during reentry at the end of any one of the three orbits, should an emergency require.

All stations are equipped for voice and telemetry communication with Mercury spacecraft, with the exception of White Sands and Eglin. Cape Canaveral, Bermuda, Muchea, Australia, Hawaii, Guayamas, Mexico, and Pt. Arguello, California have command capability as well as accurate radar equipment which transmits tracking data to the central computing facility (Goddard Space Flight Center, Greenbelt, Maryland.)

The operation control center for Mercury flights is located at Cape Canaveral with a backup control center (for insertion verification) located at Bermuda. The Bermuda station functions primarily as an extension of the Cape center. All of the data from Mercury flights -- computed trajectory data, telemetry data, and other forms of communications, whether they be real-time from Hawaii to Canaveral stations or teletype summary data from the other remote stations -- will be funneled through Goddard Space Flight Center to the Mercury Control Center at the Cape. The data will be presented at the Control Center in a number of ways to allow immediate decisions regarding the status of the flight.

The range stations have displays similar to the Mercury Control Center (with regard to spacecraft telemetered quantities) and are grouped in about the same way. A flight director is on station at each site and will serve as capsule communicator. Should the site be a command station, he will be able to initiate the command which will bring the spacecraft out of orbit at a predetermined time.

Each of the stations will prepare a summary containing information on the status of the mission to be transmitted back to the Mercury Control Center and to other range stations.

All of the stations located in the United States, Hawaii, Mexico, Bermuda, and Australia have direct voice communications with the Mercury Control Center. These stations will have the capability of transmitting radar data to the Goddard facility for determining spacecraft orbit. In turn, the Goddard Center will provide radar acquisition data to these stations and continuous orbital data to the Canaveral Control Center and Bermuda. Also, during Mercury flights, continuous computations on the time of retrofiring will be performed by Goddard and transmitted to the appropriate stations for resetting of the spacecraft's onboard retrotimer.

A high-reliability radio communication system between Canaveral, Goddard, and Bermuda has been provided to transmit real-time trajectory data. However, because of the extremely critical nature of this data link and the absolute necessity of the capability to make important command decisions at Bermuda, redundant or backup facilities have been provided at this site.

During the Mercury-Scout mission, only a small complement of Mercury flight controllers will deploy to

the sites and will serve only as observers. Operation of the stations will be handled by the permanently assigned personnel at the sites, under the direction of a Maintenance and Operations supervisor.

An estimated 400 engineers and technicians will man the range stations during the Mercury-Scout I exercise.

THE LAUNCH VEHICLE

The four Scout rocket stages and the vehicle's auxiliary parts are:

First Stage: Algol, 30 feet long, 40 inches in diameter, and developing 103,000 pounds of thrust, is fin-stabilized and controlled in flight by jet vanes.

Second Stage: Castor is 20 feet long, 30 inches in diameter and has a thrust of over 62,000 pounds. On the Scout, the Castor is stabilized and controlled by hydrogen-peroxide jets.

Third Stage: Antares is 10 feet long and 30 inches in diameter with a thrust in excess of 13,600 pounds. Stabilized and controlled by hydrogen-peroxide jets and utilizing lightweight plastic construction throughout its design, Antares is a scaled-up version of the fourth stage and is the only motor developed specifically for Scout.

Fourth Stage: Altair, six feet long, 18 inches in diameter, and having 2,800 pounds of thrust, is the smallest of the four Scout stages. The spin-stabilized Altair formerly was known as X-248. It is the third stage on the Delta launch vehicle and was the first fully developed rocket to utilize lightweight plastic construction throughout.

Auxiliary Parts: The added Scout airframe parts consist of control surfaces surrounding the nozzle of the first stage, transition sections connecting the four rocket stages, a Fibreglas-phenolic protective heat shield which covers the third and fourth stages plus payload, the fourth stage spin-up table, and the payload attachment structure.

SEQUENCE OF EVENTS

<u>TIME (Seconds)</u>	<u>EVENTS</u>
0.0	First stage ignites.
41	First stage burns out
74	Second stage ignites; third stage heat shield released; first stage separated.
115	Second stage burns out.
116	Third stage ignites; second stage separated. Fourth stage heat shield released; payload anten- nas erected.
155	Third stage burns out.
470	Spin motors ignite.
471	Fourth stage ignites; third stage separated.
510	Fourth stage burns out; satellite injected into orbit. Attached to burned out fourth stage casing.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1220 W. GUYTON, NORTHWEST WASHINGTON 25, D. C.
TELEPHONES: DULLEY 2-0323 EXECUTIVE 3-0200

FOR RELEASE: October 30, 1961

RELEASE NO. 61-240

INTERNATIONAL SATELLITE & SPACE PROBE SUMMARY

The following space vehicles are in orbit as of this date:

<u>NAME/COUNTRY</u>	<u>LAUNCH DATE</u>	<u>TRANSMITTING</u>
Explorer I (US)	Jan. 31, 1958	No
Vanguard I (US)	Mar. 17, 1958	Yes
*Lunik I (USSR)	Jan. 2, 1959	No
Vanguard II (US)	Feb. 17, 1959	No
*Pioneer IV (US)	Mar. 3, 1959	No
Explorer VI (US)	Aug. 7, 1959	No
Vanguard III (US)	Sept. 18, 1959	No
Explorer VII (US)	Oct. 13, 1959	Yes
*Pioneer V (US)	Mar. 11, 1960	No
Tiros I (US)	Apr. 1, 1960	Yes
Transit I-B (US)	Apr. 13, 1960	No
Spacecraft I (USSR)	May 15, 1960	No
Midas II (US)	May 24, 1960	No
Transit II-A (US)	June 22, 1960	Yes
NRL Satellite (US)	June 22, 1960	No
Echo I (US)	Aug. 12, 1960	No
Courier I-B (US)	Oct. 4, 1960	Yes
Explorer VIII (US)	Nov. 3, 1960	No
Tiros II (US)	Nov. 23, 1960	Yes
Samos II (US)	Jan. 31, 1961	No
*Venus Probe (USSR)	Feb. 12, 1961	No
Explorer IX (US)	Feb. 16, 1961	No
Discoverer XX (US)	Feb. 17, 1961	No
Discoverer XXI (US)	Feb. 18, 1961	No
Explorer X (US)	Mar. 25, 1961	No
Discoverer XXIII (US)	Apr. 8, 1961	No
Explorer XI (US)	Apr. 27, 1961	Yes
Transit IV-A (US)	June 29, 1961	Yes
Argun-SR-3 (US)	June 29, 1961	Yes
Discoverer XXVI (US)	July 7, 1961	No
Orion XII (US)	July 12, 1961	Yes
Midas XII (US)	July 12, 1961	Not Available
Explorer XII (US)	Aug. 5, 1961	Yes
Discoverer XXIX (US)	Sept. 12, 1961	No
Discoverer XXXII (US)	Oct. 13, 1961	Yes
Midas IV (US)	Oct. 21, 1961	Not Available

*In solar orbit; others in Earth orbit.

CHRONOLOGICAL SUMMARY (October 30, 1961)

Earth Orbit: US - 31
USSR - 1

Solar Orbit: US - 2
USSR - 2

Transmitting: US - 12
USSR - 0

COMPARATIVE SUMMARY (Launched
to date)

Earth Orbit: US - 34
USSR - 13*

Solar Orbit: US - 2
USSR - 2

Lunar Impact: USSR - 1

*Lunik III passed once around the
Moon, then into Earth orbit.

NOTE:

Holders of Space Activities Summary Charts are requested
to make the following changes:

Change the code number of Discoverer XXIX Chart to
S-61-24

Change the launch date for Discoverer XXXII to
October 13, 1961



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST WASHINGTON 25, D. C.
TELEPHONES: Worth 2-4155 Worth 3-6925

FOR RELEASE: UPON DELIVERY
(expected about 12 noon, EST)

RELEASE NO. 61-241

Address by
James E. Webb, Administrator
National Aeronautics and Space Administration
before the
Aero Club of Washington
Washington, D. C.
October 31, 1961

It must be a great satisfaction to the founders of the Aero Club to know that they had the foresight to choose an organization title which would not become obsolete as the science and technology of flight progressed. "Aero," as Webster points out, is a combining form which leaves room for you to add space to your original interest and knowledge in aeronautics.

Today I would like to discuss with you some of the highlights of both the "aero" and "space" aspects of our national program. There is, of course, no clear-cut dividing line between many of the fields of research and development in aeronautics and space. The supersonic airplane, for example, uses atmospheric air for combustion; the rocket carries its own oxidizer--yet jets and rockets have similar fundamental problems of aerodynamics, combustion, and materials. The stratosphere, where jet planes operate merges imperceptibly into "space."

Some of the results of aeronautical research are applicable to spacecraft, and some of the work to develop space propulsion systems and vehicles feeds back into the technology of advanced aircraft. It is vitally important to our security and well-being that the United States achieve and maintain leadership in both these fields.

The National Aeronautics and Space Act of 1958, which established the agency I serve, stipulated:

"...that activities in space should be devoted to peaceful purposes for the benefit of all mankind."

to: It is the role of NASA to initiate and support projects

Expand human knowledge of the phenomena in the atmosphere and in space;

Improve the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

Develop and operate space vehicles;

Study the benefits to be gained for mankind through space activities;

Preserve the role of the United States as a leader in aeronautical and space activities for peaceful purposes;

Interchange information between the civilian and military agencies to assure maximum effectiveness of discoveries and know-how for all purposes;

Cooperate with other nations in space activities and in peaceful application of the results;

and

Seek the most effective utilization of scientific and engineering resources of the United States in achieving these goals.

Five months ago, President Kennedy called for a national commitment to a ten-year effort to advance, at the most rapid rate possible, the broad technology of space exploration with maximum advances in science to culminate in a manned expedition to the moon. In his May 25 State of the Union Message, the President said:

"Now is the time for a great new American enterprise--time for this nation to take a clearly leading role in space achievement..."

The first increment of this program was approved in the last session of Congress. Its implementation involves not one, but a number of Government agencies--including the Department of Defense, the Atomic Energy Commission, the Department of

Commerce, and the National Aeronautics and Space Administration.

Universities are supporting the basic research activity and will supply the program with increasing numbers of qualified scientists and engineers.

American industry is designing and fabricating the boosters, spacecraft, launch facilities, and worldwide tracking stations for the many different types of space missions.

The aeronautics and space program is truly a national effort. The objective of a manned lunar exploration within the shortest time possible requires the planning and fitting together of a large number of actions, a systematic organization of the effort, and a constant evaluation of progress. The results, and the effectiveness of the men and means employed must be constantly reviewed by a leadership capable of hard-boiled adjustment to overcome deficiencies and to exploit opportunities as they may arise.

Historically, our military services have participated in and made great contributions to the development of our resources as a nation, to our great explorations such as the Lewis and Clark Expedition and those in the Antarctic and during the International Geophysical Year. They are now making great contributions to our space effort.

It is, also, an interesting fact that our nation's leaders in aviation and aerodynamic research, who have done so much to provide the foundation for our military and commercial air superiority, through the National Advisory Committee for Aeronautics, are now through its successor agency, NASA, applying their experience, skill, and leadership in this vast new effort. I refer particularly to Dr. Hugh Dryden, Dr. Abe Silverstein, and Ira Abbott. Of course, Joe Walker, and others of X-15 fame are familiar to all of you.

In this same vein, I believe it is important to keep in mind that some of our nation's most outstandingly qualified men who have over the years made great contributions to our national aviation position in universities and in industry have accepted leading roles in our space program.

Dr. Robert Seamans before joining NASA as Associate Administrator, spent fifteen years working with Dr. Charles Draper in the Instrumentation Laboratory for Aeronautics at the Massachusetts Institute of Technology and also taught at that University. He then went on to spend five years with Radio Corporation of America.

Mr. Thomas Dixon, who recently joined us as Deputy to Dr. Seamans, has distinguished himself for more than sixteen years with the Rocketdyne Division of North American Aviation in the development of our most modern propulsion systems for the space age. He rose to Vice President at Rocketdyne.

Mr. Brainerd Holmes, who tomorrow will take up his duties as Director of the Office of Manned Space Flight Programs, has had a distinguished career with the American Telephone and Telegraph Company and the Radio Corporation of America and occupied a leading role in the successful accomplishment of our ballistic missile early warning system.

I could mention many other men in leadership positions in NASA who bring the highest personal, technical, and professional qualifications to this effort, but I mention these three particularly to show that there is a joining in them, as they exercise their responsibility for leadership and management, high technical qualifications in the three major fields of instrumentation, of propulsion, and of electronics. There is the old saying in American industry that if you want to make soap, you have to get a man who knows how to make soap. These men, and many others associated with them, know the technical side of aeronautics and space and are all experienced in the management of large activities. Each has demonstrated a personal earning capacity far beyond what the Government is able to pay for their services. Each is thoroughly familiar with the opportunities and problems associated with our most important technical military weapons system development efforts. It is fortunate for this nation that men with these high qualifications and such experience are willing to forego large earnings in industry and a more normal personal and family life to supply the leadership needed in our national space effort.

Our senior military leaders in these highly technical and complex fields are making the same kind of personal contribution, and the teaming of these civilian and military leaders is taking place in a manner to ensure the success of the program in the best tradition of American public service.

Before this group, it is not necessary to compare the fifty-eight years of man's powered flight in the atmosphere with the four years since man proved his ability to achieve space flight. But it is important to recognize that the lead time of 45 years, from the Wright Brothers to practical jet aircraft, offers us some measure of the magnitude of the technical problems involved. To accomplish all that must be done to mount a successful manned lunar expedition within ten years will require every possible acceleration in technological advances and their application. Research and development in direct and in supporting areas must also be pursued to the utmost of our abilities, and without let-up.

There are a number of important reasons for a national commitment to a large-scale augmented space program:

The United States must master spaceflight in both its unmanned and manned aspects as insurance against finding ourselves with an over-all technology inferior to that which the Russians will develop as they design and build advance spacecraft and work out supporting techniques for manned voyages to the moon. If we were to permit the Russians to surpass us, the time would certainly come, in line with their own announced intentions, when we would find ourselves on the receiving end of their advanced space technology, employed for military and economic pressure.

Space research is a vigorously expanding field, whose growth is comparable to the development of nuclear physics after World War II. The NASA scientific space program involves both manned and unmanned lunar exploration. From the scientific standpoint, exploration of the moon is of great importance. Having no atmosphere, winds, or rains, the moon offers scientists a chance to study the very early matter of the solar system in practically the form in which it existed billions of years ago.

Another important point is that to millions of people, today's space achievements have become a symbol of tomorrow's scientific and technical supremacy. We simply cannot afford a second-best space effort, and we must always keep in mind that the way in which the knowledge produced by space science and technology is put to use will have powerful effects on the minds of men throughout the world. This is the reason that from the outset, our policy has been to share our space knowledge with the world scientific community. We are cooperating with a growing number of nations in many projects to increase knowledge of the earth's environment and of the universe. In these cooperative projects, we do not exchange funds. Each nation agrees on the work to be done, and each then pays its own costs. Each participating nation stands to gain many valuable contributions through interchange of ideas between scientists and scientific organizations in scores of other nations.

Our country and the world will derive great practical benefits from the accelerated space program. In marshalling and developing the scientific and technical resources we will need to accomplish the manned lunar exploration, we will be advancing a technology that is certain to radiate great and diversified benefits to almost every area of industrial and intellectual activity.

The national investment in space exploration is already producing new materials, metals, alloys, fabrics, and compounds which have gone into commercial production. More than 3,200

space-related products have been developed in the United States. They come from the 5,000 companies and research outfits now engaged in missile and space work.

Direct, practical applications of earth--satellite technology promise to return early and outstanding dividends in the form of improved communications and weather-forecasting services.

Many in this audience have, from time to time, sighted NASA's Echo I passive communications satellite, which was launched in 1960. It has been seen, like a bright moving star, by people in most countries. The huge, aluminized plastic sphere, now in orbit for more than a year, has proved that it is possible to transmit telephone and other electronic messages at transoceanic distances by reflecting radio signals from a satellite.

Great interest has been shown by private firms in both the Echo concept and in "active," or "repeater" satellites that can receive messages at one point over the earth's surface and transmit them to another or store them on tape, and later re-transmit them to ground receiving stations.

First among these is Project Relay, for which the Radio Corporation of America is designing and constructing for NASA, an experimental communications satellite to be launched in 1962. Relay satellites will orbit at three to four thousand miles from the earth and will be used to demonstrate intercontinental television as well as telephone communications.

The second project known as "Telestar" is a cooperative agreement between the American Telephone and Telegraph Company and NASA. Two or more active satellites will be built by A.T.&T. at its own expense. They will be launched by NASA, with A.T.&T. paying the costs and with the knowledge gained fully available to advance the state of the art. These will orbit at six to seven thousand miles from the earth. The third project is a very lightweight satellite called SYNCOM, for which NASA also has a contract with the Hughes Aircraft Corporation. SYNCOM will be flown in what has become known as a 24-hour, or synchronous orbit at the height of 22,300 miles. With the right velocity and in an equatorial plane it will appear stationary over a fixed point on the earth. SYNCOM will be launched late next year as another experimental relay link for telephone and telegraph messages.

One expert in the communications industry states that a single satellite, costing about \$40,000,000 and placed in a 22,300-mile orbit, could accommodate as much traffic as a \$500,000,000 cable system.

Leaders in the communications industry are convinced that communication satellites present an enormous potential for increasing our long-distance communications resources. For the first time, worldwide television becomes foreseeable, and entirely new forms of global communications, such as closed-circuit TV on an international basis, will become possible. In the future, information from any nation may be fed into computers in a central location at costs that may open great opportunities for better factual analysis and decision.

NASA's TIROS series of satellites has demonstrated the possibilities of vastly more accurate and longer-range weather forecasting. TIROS I transmitted nearly 23,000 television pictures of the earth's cloud patterns. TIROS II, launched last November, has transmitted more than 40,000 pictures and has reported important information about the atmosphere and the radiation of solar heat back from the earth.

TIROS III pictures of Storm Eliza in the Pacific and Hurricanes Carla and Esther on the Atlantic and Gulf Coasts were valuable aids to the Weather Bureau in tracking these cyclonic winds and issuing warnings. In fact, TIROS III spotted Esther two days before the giant wind could have been located by other means. NASA also used TIROS III for weather support of Astronaut Girsom's July 21 Mercury suborbital flight.

Arrangements have been made to keep a TIROS weather satellite in orbit at all times until a follow-on system operated by the United States Weather Bureau and based on the Nimbus satellite is brought into being. Congress has appropriated funds for the project, and the Weather Bureau will this year initiate the first steps toward the Nimbus worldwide meteorological network. Meanwhile, an international conference of all nations interested in participating in this new worldwide weather satellite system has been called and will be held within the next few weeks.

A recent report by the House Committee on Science and Astronautics states that "An improvement of only 10 percent in accuracy (of weather forecasting) could result in savings totaling hundreds of millions of dollars annually to farmers, builders, airlines, shipping, the tourist trade, and many other enterprises.

Since January 31, 1958, this country has successfully launched 54 earth satellites, two satellites around the sun, and two deep space probes. Among our most successful experiments to date have been the Pioneer series of space probes. Pioneer V, for example -- launched into solar orbit on March 11 of last year -- was tracked into space to a distance of 22.5

million miles, still the greatest distance any man-made object has been tracked. The satellite sent back scientific data on conditions in space for more than three months until communication contact was lost on June 26, 1960.

We are developing advanced launch vehicles for both scientific missions and for operational systems. They will have greatly improved load-carrying capability for unmanned space experiments such as Ranger which will land instruments on the moon, and Surveyor, a spacecraft that will be able to make a so-called "soft landing" on the moon with more delicate scientific instruments. Also under development are spacecraft that will fly close to Venus and Mars.

The suborbital flights of American Astronauts Alan Shepard and Virgil Grissom this year were important steps in Project Mercury, the first phase in the United States program for manned spaceflight. The flights were made to test the man and our first man-carrying spacecraft, the Mercury. These flights were to determine the quality of the vehicle, its systems, and man's ability to handle them in space. These are necessary steps to putting an astronaut in orbit around the earth.

In our manned spaceflight program, following Project Mercury, is Project Apollo whose ultimate goal is a manned lunar landing. The Apollo spacecraft will be large enough for living and working quarters to accommodate three men.

Apollo will first be placed into an earth orbit by the Saturn launch vehicle which had its first stage test flight last week. This is an eight-cluster stage with a thrust of 1,500,000 pounds. After the Apollo spacecraft is used as a manned earth-satellite laboratory, it will be sent on voyages deeper into space. These will include a three-man expedition around the moon, and finally an actual moon landing and return late in this decade. The Saturn launch vehicle which is now under development will not be powerful enough for circumlunar flight and lunar landing. NASA is developing much larger launch vehicles such as the Nova, which will be almost as tall as the Washington Monument and will deliver thrusts of more than 12 million pounds.

The policy of the present Administration is to press forward in all related areas of science and technology at the most rapid rate that can be justified by the state of the art, without involving the wastefulness of crash programs.

We have analyzed 2,200 separate tasks with respect to possible schedules and probable costs. These elements were fitted into a single master schedule through massive computer runs (PERT) to determine that manned lunar exploration was feasible within the ten-year period. We have found through these studies an acceptable course along which to initiate action, but it is important to recognize that we still face

a number of problems which are unresolved and await further research and technological advance.

For those particularly interested in space science, I would like to emphasize that basic science projects have not been subordinated to manned space flight but rather have been increased and given added emphasis as necessary first steps in all our programs. Research that can be conducted here on earth on the scientific and technological problems associated with space has been increased wherever this was the most efficient way to accomplish the desired results.

There have been so many dramatic developments in the space program that people are prone to forget that NASA is pursuing vigorous, basic research in aeronautics. Our research centers concern themselves with everything from pure research on gas-flow phenomena, to applied research on aerodynamic heating, stability, and control of advanced vehicles, and chemical and metallurgical studies of materials, to name only a few.

Among other important areas under intensive research is that of work with advanced experimental aircraft such as the X-15 experimental airplane. All of you have read how new speed and altitude records are being scored by the rocket-powered X-15 in almost every flight. Within the past two weeks, NASA's Joe Walker set a new speed record of 3,920 miles an hour, or a little more than five times the speed of sound. That's about twice the velocity of a bullet. Walker's partner, Major Bob White, not too long ago piloted the X-15 to a record 217,000 feet or about 41 miles altitude.

In the civil aviation field, the sonic barrier stands in the way of greater speed for current jet transports, although those we have today carry passengers to their destinations in little more than half the time required a few years ago. Yet, we know that it is feasible to develop a commercial transport that will fly at three times the speed of sound.

Private industry unaided could not finance the job. The NASA budget for Fiscal Year 1962 contains substantial increases for aeronautics research, including \$6,200,000 for research to aid the Federal Aviation Agency in the development of supersonic transport aircraft. This is double the amount for such research in the 1961 budget. NASA work in the supersonic transport field is concerned with aerodynamics, propulsion, structures, and materials, and in supporting research effort by the industry.

To provide for these industry studies, the FAA budget for 1962 includes 11 million dollars.

Recently, the two agencies -- NASA and FAA -- joined with the Department of Defense to look into the subject of supersonic transport development. A Task Force of the three agencies gathered information from industrial and Government sources.

We have reached agreement on certain basic principles for the project. These are that the program is one of Government assistance to industry; that competition should be used to maximum advantage; that direct Government financial assistance should be provided only to the point from which industry can carry on alone; that the civil air carriers should participate actively; and that the maximum feasible recovery of direct Government expenditures should be sought.

It is especially interesting, I think, that the Task Group emphasized this observation: "The B-58 and the B-70 bomber programs and broad earlier research and experience of supersonic flight from which they evolved provide the United States with a unique capability for developing a supersonic transport."

Now, let us turn to industry thinking on the subject of supersonic transports. In the first place, industry estimates that there is a world market for upwards of 200 such planes. As manufacturers envision these planes, they would have a range of 4,000 miles, or roughly the distance between New York and Berlin. They would carry from 100 to 150 passengers and cruise at about 2,000 miles an hour at 70,000 feet.

Considerable research will be required for the design of a wing that will be efficient at both low and high speeds. One idea is for a wing that can be mechanically swept back to a "delta" shape when the plane enters its high speed range. We have already established research programs to study fuselage and wing structural materials that will withstand the heat conditions of Mach 3 flight. It is expected that surface operating temperatures will range from 450 to 600 degrees Fahrenheit at Mach 3.

On the problem of engines -- and this is a problem -- industry representatives believe that a new type must be developed. Present engines are not considered suitable for the supersonic transport, and there is almost unanimous preference for some form of turbofan engine. The greatest power need will be at altitudes over 40,000 feet where the plane accelerates from subsonic into the supersonic speeds.

The primary requirement is to maintain high efficiency over all speed ranges. Ideally, at subsonic speeds, the supersonic transport engine should be as efficient as present jet-transport engines and, at supersonic speeds, nearly twice as efficient. This is a tough requirement, but we do not see serious fundamental obstacles to building such an engine.

In addition to high efficiency, we must with supersonic engines: 1) maintain noise levels little higher than those of current engines; 2) develop thrust reversers for high speed; 3) utilize cheap fuels and lubricants; and 4) solve a host of other problems, many of them undefinable at present. It will take a long time -- probably extending us into the 1970's -- and it will take many millions of dollars.

The proposed supersonic transports can use existing international airports, but will require higher touchdown speeds and longer landing distances than current subsonic jets. It is believed that touchdown speeds will range from 170 to 145 miles per hour with runway lengths of 8,000 to 9,000 feet. These compare with 120 to 130 miles per hour and 6,500 feet for the present subsonic jet aircraft.

One of the problems -- concerning all of us -- that must be overcome in this venture into the supersonic commercial field is that of noise. NASA is progressing with its research on jet noise, to learn more about the mechanisms that cause it, and on methods of suppressing it. Jet noise is not only a community nuisance, but it also causes aircraft structural fatigue and equipment failures. Our research is particularly aimed at reducing further the noise generated by jet engines of the fan type.

Noise of air rushing by the outer skin of an airplane in the so-called "boundary layer" is also a vexing problem today, as evidenced by the tons of acoustic insulation used in high-speed jet transports. This problem will, of course, become even more severe as greater speeds are attained. NASA is working hard on research on boundary layer noise, using both high-speed wind tunnels and in-flight experiments with the X-15 and other flight research vehicles.

Still another aspect of the noise problem is the sonic boom. NASA experimental work has resulted in a good understanding of many of the factors involved. Much additional work is required to gain the information needed to predict accurately the boom expected from supersonic transports. We must determine operating techniques to minimize annoyance on the ground. Fortunately, we have established the fact that sonic booms do not cause problems for other aircraft flying through the boom-pressure wave created by supersonic aircraft.

Safety is another problem that can scarcely be over-emphasized. We are constantly engaged in research on such factors as wet runways, improved tires and treads, more efficient braking, and reduction of fire hazards.

Let me tell you a little about some interesting and extremely important studies we have recently made of the effects of slush on runways. At our Langley Research Center, we have a test arrangement in which a 100,000-pound car is accelerated hydraulically and runs down a track at 150 miles an hour. Time after time, an airplane wheel carried by this car has been run through slush at various depths to find the effects on landing and take-off of our present-day jet aircraft. Some of the discoveries have been surprising.

For example, as little as one-half inch of slush on an airport runway can seriously hamper the take-off of a jet transport. A rough rule of thumb developed from the data obtained in these tests is that for each half inch of slush or water on the runway, approximately 1,000 feet more of ground run is required for a jet transport to take off.

This is the kind of research that might be called "an ounce of prevention." There is no way of giving meaningful statistics or figures but, unquestionably, accidents have been prevented and more will be, as a direct result of this research.

I have touched upon only a few examples of the many problems that NASA is attempting to solve in the field of aeronautics. In the past, unfortunately, our rapid progress to new aerial frontiers has not always been accompanied by full commercial exploitation of the scientific and technical information acquired. We still need to:

- ...Develop a high degree of versatility in our aircraft, thus eliminating many of the specialized types.

- ...Increase the maximum-minimum speed ratio.

- ...Reduce operating costs.

- ...Provide true all-weather capability.

- ...Improve the acceptability of the various air vehicles from the viewpoints of noise, safety, and convenience.

- ...Provide new capabilities, such as vertical take-off which will broaden the usefulness of the machine.

During the next 10 years, NASA research of this nature will provide the foundations for the more useful and more versatile aircraft of the future.

I would like to add a few words about NASA's organization, and funding.

The organization problems of the new program have been acute. However, in the past eight months we have established a pattern that is, at one and the same time, practical and flexible. It takes account of the best abilities of our senior people, establishes strong leadership in our research and operational centers, gears authority and responsibility together, and provides for sensitive but effective command and control of the resources required in the space program.

We have divided our work into four major program categories: 1) advanced research and technology in aeronautics and space; 2) scientific study of the space environment and celestial bodies, through all available disciplines, and by instrumented unmanned satellites and space probes; 3) application of earth satellites to such immediate uses as weather observation, global communication and navigation; and 4) exploration of space by man.

Each of the four NASA Program Directors, within his particular program area, has over-all responsibility for projects, establishes technical guidelines, budgets and programs funds, schedules each project, and evaluates and reports progress.

The Directors of NASA's research and development centers report directly to the Associate Administrator who serves as general manager. In this way, the directors have an increased voice in policy-making and in program decisions.

Looking back at highlights of the past eight months, there was the work involved in evaluating the resources and requirements, integrating our efforts with those of the Department of Defense and other Government agencies, working with the Director of the Budget, the Vice President and the Space Council, and the President, himself, to determine the total range of Executive Branch requirements. There were the approximately thirty appearances before Congressional bodies to justify the President's recommendations; there were the innovations required in the communications satellite field to carry on the research and development to meet governmental requirements and at the same time bring into play, in a manner consistent with the public interest, the very large resources of the principal potential user of any foreseeable system (the American Telephone and Telegraph Company).

For Fiscal Year 1962, the National Aeronautics and Space Administration has a budget of \$1,671,750,000. This includes \$245,000,000 for construction of new and supporting facilities and \$1,220,000,000 for research and development. Eighty percent of the research and development budget goes to industry

and to private organizations. Funds for advanced aeronautics and supersonic transport research total about \$31,000,000.

The 1962 NASA program is approximately double that for 1961. Funding requirements will double again in 1963 to meet the goals recommended by President Kennedy.

In conclusion, it has been only four years since the first man-made satellite orbited the earth. The rate of change in this new science and technology is tremendous.

The United States program is based on securing for the peaceful benefit of all mankind the positive gains to be attained through an expansion of the knowledge of the universe, the utilization of space for many valuable purposes, the improvement of flight within the atmosphere, and the advancement of our scientific and technological progress at the most rapid rate possible. We now have, I think, a national space effort characterized by initiative on the part of many able men and responsibility on the part of those who had to make the governmental decisions, all in the best tradition of American democracy.

We recognize that our security would be jeopardized if we did not keep up to date but permitted ourselves to slip into a second-best position.

We are determined to make the effort required to be first in aeronautics and space.

END

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
400 HANFORD AVENUE, S. W.
WASHINGTON, D. C.

RELEASE NO. 61-242

FOR RELEASE: IMMEDIATE
October 31, 1961

DATA FROM FIRST SATURN (SA-1) TEST FLIGHT

Analysis of the extensive data radioed back from the first Saturn space vehicle (SA-1) launched by NASA from Cape Canaveral, Fla., on October 27, 1961, revealed that the rocket attained a range of 214.7 statute miles and a peak altitude of 84.8 miles.

Maximum velocity was 3,607 miles an hour. Velocity at engine cut-off was 3590 miles an hour.

The length of the flight was eight minutes and 3.6 seconds. Final weight of the rocket at lift-off was 927,000 pounds.

Thrust achieved at lift-off was 1.296 million pounds. The maximum thrust at altitude, which occurred just before cut-off, was 1.515 million pounds.

The vehicle's four inboard engines burned 109.37 seconds and the four outboard engines burned 115.15 seconds.

The period of "hold-down" on the launch pedestal -- from the moment of initial ignition to lift-off -- was 3.97 seconds. The eight engines were ignited in pairs requiring a total period of 3/10th of a second.

Project: Discoverer XXXII 1961 Alpha Gamma Project Direction: U.S. Air Force Launched: September 13, 1961 3:23 p.m., EDT From: Vandenberg AFB, Calif. Lifetime: 15 Months (Estimated)	Major Objectives: Reliability testing of Agena "B"; improvement of orbital period control; ejection and recovery of capsule; investigation of radiation effects. Major Results: Orbit achieved. Capsule ejected after 18th orbit and recovered in mid-air north of Hawaii.
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S-61-29

Flight Program

Launch Vehicle: Thor Agena. Stages: (1) Modified Thor Booster, (2) Agena B.

Lift-Off Weight: 115,500 lbs. Dimensions: 81 ft. high; 8 ft. base diameter

Program: Place satellite in near-polar Earth orbit and recover capsule.

Program Results: Orbit achieved and capsule retrieved.

Perigee (Miles): 147.07	Inclination: 81.69°
Apogee (Miles): 246.06	Period: 90.84 min.

Velocity: 17,500 (Average)

Payload And Instrumentation

Dimensions: Second stage and capsule: 25 ft. high, 5 ft. diameter

Payload Configuration: Cylindrical

Payload Weights: 2,100 lbs. (Approx.), including second stage casing and 300 lb. reentry capsule, retrorockets and recovery aids.

Instrumentation: Instruments for testing of adjustments made as a result of deficiencies found in previous Discoverers; radiation measurement equipment.

Transmitters: 20.005 MC

Power Supply: Not available

DISCOVERER XXXII

Additional Data: Capsule contained experiments to study effects of radiation on: (1) various metal samples, (2) genetic properties of seed corn, (3) shielding materials, and (4) solar cells. A transmitter on Discoverer vehicle emitted signals for investigation of ionospheric effects on radio propagation.

Secret:

Department of Defense

Date: October 16, 1961

Washington 25, D.C.

Project: Midas IV 1961 Alpha Delta Project Direction: U. S. Air Force Launched: October 21, 1961 From: Vandenberg AFB, Calif. Lifetime: Not available	Major Objectives: (1) Place experimental satellite in Earth orbit, (2) eject West Ford dipoles. Major Results: Orbit achieved. Dipoles ejected.
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Flight Program

Launch Vehicle: Atlas Agena. Stages: (1) Modified Atlas 'D' (2) Agena 'B'

Lift-Off Weight: 263,500 Lbs.

Dimensions: 98 ft. high, 10 ft. base diameter

Program: Place satellite in near-circular, polar orbit

Program Results: Orbit achieved

Perigee (Miles): Not available

Inclination: Not available

Apogee (Miles): Not available

Period: 172 Min.

Velocity: Not available

Payload And Instrumentation

Dimensions: 30 ft. high, 10 ft. diameter Payload Weight: 3500 Lbs. (Approx.)
 total weight for orbit. (Includes entire second stage).

Payload Configuration: Not available

Instrumentation: Not available

Transmitters: Not available

Power Supply: Not available

Additional Data:

Sources:

USAF Department of Defense

Date: October 25, 1961

Project: Discoverer XXXIII

Project Direction: U. S. Air Force

Launched: October 23, 1961
4:22 PM EDT

From: Vandenberg AFB, Calif.

Lifetime: Not applicable

Major Objectives: Test design reliability of orbit, reentry and recovery systems; orbit, eject and recover capsule.

Major Results: Orbit not achieved.

*Flight Program*Launch Vehicle: Thor Agena. Stages: (1) Modified Thor booster,
(2) Agena B.

Lift-Off Weight: 115,500

Dimensions: 81 ft. high; 8 ft. base
diameter

Program: Place Satellite in near-polar Earth orbit and recover capsule.

Program Results: Orbit not achieved, apparently due shut-down of Agena prior to attainment of necessary velocity.

Perigee (Miles): Not applicable

Inclination: Not applicable

Apogee (Miles): Not applicable

Period: Not applicable

Velocity: Not applicable

*Payload And Instrumentation*Dimensions: Second stage and capsule:
25 ft. high, 5 ft. diameterPayload Weight: 2,100 lbs. (Approx.)
including second stage casing and
300-lb. reentry capsule.

Payload Configuration: Cylindrical

Instrumentation: Instruments for testing adjustments to eliminate previous Discoverer deficiencies; experiments to provide data for advanced spacecraft design.

Transmitters: Not available

Power Supply: Not available

Additional Data:

Sources:

USAF, Department of Defense

Date: October 28, 1961